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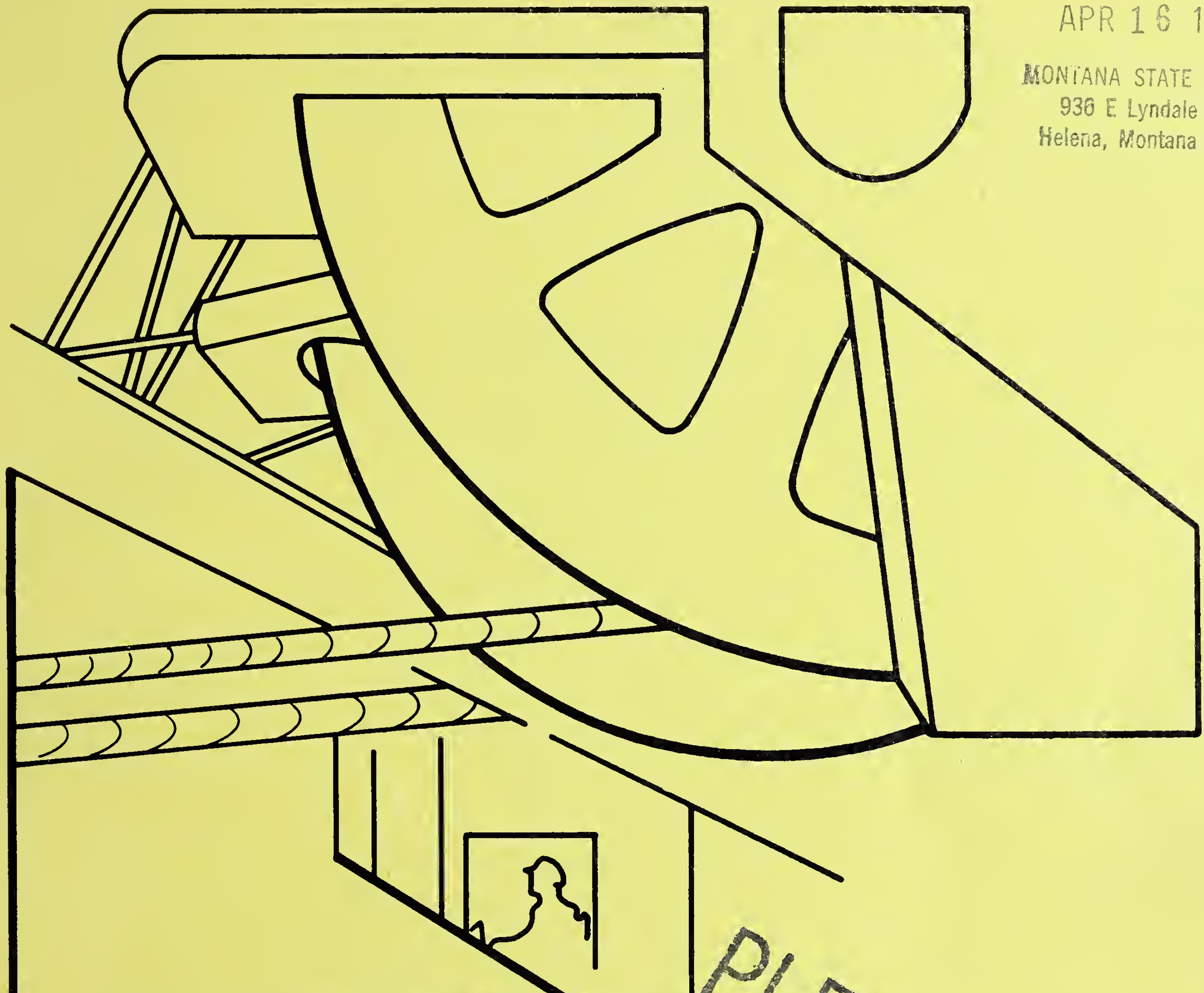

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Western Energy Company's
Rosebud Mine — Area E Extension

ENVIRONMENTAL IMPACT STATEMENT

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Draft Environmental Impact Statement

Western Energy Company's Rosebud Mine, Area E Extension

Rosebud County, Montana

Montana Department of State Lands

March, 1981

Gareth Moon, Commissioner

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SUMMARY

1. Action under consideration: Western Energy Company proposes to extend Area E of its Rosebud mine into sections 2 and 11, T. 1 N., R. 41 E. The extension would require an amendment of Western Energy's existing strip mining permit. The Commissioner of State Lands must decide whether to (1) approve the permit amendment or portions of the amendment as proposed, (2) approve the permit with stipulations, or (3) deny the amendment or portions of the amendment.

2. Brief description of the company's proposal: Western Energy proposes to mine 276 acres of its existing Federal and private coal leases in Area E through 1984. An additional 174 acres would be used for haul roads, topsoil stockpiles, and a highwall reduction area. Annual coal production would remain at about the current rate of 3 million tons/year. The proposed plan would complete Western Energy's mining operations in Area E. Active reclamation of disturbed areas would continue at least until 1987.

3. Summary of impacts by discipline:

Geology--impacts on topography and geomorphology would not be significant because the company's proposed mine plan would minimize erosion over the long term. Erosion on the reclaimed minesite would at first be higher than on most native range lands near Colstrip, but erosion rates are expected to approach premining levels within 3-4 years after revegetation.

Hydrology--impacts could be significant, because continued mining could add additional saline waters to the headwaters of Cow Creek. This could slightly reduce the productivity of irrigated fields and native rangeland east of Area E.

Climate--continued mining in Area E would have no significant impact on the climate. The fugitive emission sources are all at ground level and the emission rates are not of sufficient magnitude to affect either precipitation or radiation balance.

Air Quality--particulate and gaseous emissions from Area E would continue to contribute slightly to the significantly reduced air quality at Colstrip. Increases in ambient particulate and gaseous pollutant concentrations would be primarily caused by construction of Colstrip units 3 and 4, not continued mining in Area E.

Soils--impacts on soils would not be significant because the proposed soil salvage plan and complex slope system would prevent excessive loss of soil during and after mining.

Vegetation--impacts on vegetation would not be significant because Western Energy would make maximum feasible use of the reclaimed soil's potential to support diverse native vegetation. Unavoidable disturbance of the soil would probably cause a slight reduction in potential productivity, but this would not limit normal use of the reclaimed minesite for domestic livestock production and wildlife habitat.

Wildlife--continued mining at Area E would not have significant long term impacts on wildlife because Western Energy would reestablish wildlife habitats similar to those that existed before mining.

Sociology--continued mining in Area E would contribute a small amount to the continuation of existing social impacts in the Colstrip-Forsyth area, but would not measurably affect the social structure of the Colstrip-Forsyth area. This is so because the mine employees and their families are already residents, and because the mine would not cause further population growth.

Economics--approval of the Area E extension would not have a significant adverse economic impact because the mine is an existing operation that provides a tax base for Rosebud County and the two Colstrip school districts.

Community Services--continued mining in Area E would not increase the need for community services in Rosebud County. Services and facilities provided in response to construction of Colstrip generating units 1 and 2 are generally adequate for the population attributable to Area E.

Land Use--the Area E extension would not signficantly affect land use in Rosebud County, because mining the 410 acres of rangeland would temporarily reduce available grazing land in Rosebud County by only 0.02 percent. If managed properly by the landowner or grazing lessee, the reclaimed mine area would be about as productive as it was in 1975, the last year it was grazed.

Transportation--the Area E extension would not contribute significantly to the existing highway safety problems and occasional traffic delays from coal trains in the Colstrip-Forsyth area. Improvements to FAP 39 projected to be completed by 1982 should greatly alleviate both problems.

Recreation--continued mining at Area E would not significantly increase demands on developed recreation facilities or undeveloped recreation areas. The minesite itself is not a significant recreation resource.

Cultural Resources--the loss of six archeological sites and one historic site would not be significant because none are eligible for inclusion on the National Register of Historic Places. None of the sites are unusual for the northern Great Plains, and none provide important information about prehistory or recent history.

Esthetics--long term esthetic impacts would not be significant because the minesite's esthetic value, which is not distinctive for the region, would be largely restored after mining.

4. Relationship between short term uses of the environment and long term productivity:

The 11.2 million tons of coal mined from the Area E extension would be burned in Colstrip electric generating units 1 and 2. This short term use of the minesite would last through 1984, when mining in Area E would end. If the mine area were not disturbed, it would continue to provide livestock forage, wildlife habitat, and limited scenery. Those uses would be restored after reclamation without a long term reduction in productivity, compared with the premining (1975) condition. Disruption of the minesite's hydrologic function could be significant, but additional studies would be needed to determine the extent of this impact.

5. Irreversible and irretrievable commitments of resources: the mine extension would produce about 11.2 million tons of coal through 1984. About 670,000 tons of coal would not be recovered and would be lost to future mining, owing to the limitations of surface mining technology. At the average annual coal production rate of 3 million tons/year, about 675,000 gallons of diesel fuel, 48,000 gallons of gasoline, and 3 million kilowatt-hours of electricity would be used at the mine each year. Water consumption would amount to about one-third of the Rosebud mine's total, or about 23 acre-feet/year.

The existing stratigraphy would be permanently altered; however, the stratigraphy is not unusual or intrinsically valuable. The existing topography would be essentially restored by reclamation. Mixing of the stratigraphy and soil horizons would affect hydrologic conditions and revegetation potential as described in chapter II, Hydrology and Soils.

CONTENTS

Page

Summary-- iii

Chapter I. Description of the proposal under consideration------- I-1
- A. Scope of the analysis-- I-1
- B. Mine history-- I-5
- C. Western Energy Company's proposal------------------------ I-6
  - 1. Summary-- I-6
  - 2. Facilities-- I-6
  - 3. Mining plan-- I-9
  - 4. Reclamation plan-- I-10

Chapter II. Analysis of Western Energy Company's proposal-------- II-1
- A. Geology--- II-1
  - 1. Summary of impacts------------------------------------ II-1
  - 2. Description of the existing environment------------ II-1
    - a. Topography and geomorphology------------------ II-1
    - b. Overburden-- II-1
    - c. Stratigraphy and structure---------------------- II-3
  - 3. Impacts of the proposal------------------------------ II-5
    - a. Topography and geomorphology------------------ II-5
    - b. Impacts of overburden constituents------------ II-7
- B. Hydrology-- II-8
  - 1. Summary of impacts------------------------------------ II-8
  - 2. Description of the existing environment------------ II-9
    - a. Surface drainage and use------------------------ II-9
    - b. Aquifers-- II-9
    - c. Influence of existing mining------------------- II-14
  - 3. Impacts of the proposal----------------------------- II-18
    - a. Water quality-------------------------------------- II-18
    - b. Water quantity------------------------------------ II-19
  - 4. Mitigating measures---------------------------------- II-20
- C. Climate--- II-20
  - 1. Summary of impacts----------------------------------- II-20
  - 2. Description of the existing environment----------- II-21
  - 3. Impacts of the proposal----------------------------- II-21
- D. Air quality--- II-22
  - 1. Summary of impacts----------------------------------- II-22
  - 2. Description of the existing environment----------- II-22
  - 3. Impacts of the proposal----------------------------- II-25
  - 4. Mitigating measures---------------------------------- II-25
- E. Soils--- II-28
  - 1. Summary of impacts----------------------------------- II-28
  - 2. Description of the existing environment----------- II-28
  - 3. Impacts of the proposal----------------------------- II-28
  - 4. Mitigating measures---------------------------------- II-31
- F. Vegetation-- II-31
  - 1. Summary of impacts----------------------------------- II-31
  - 2. Description of the existing environment----------- II-32
  - 3. Impacts of the proposal----------------------------- II-32

G. Wildlife-- II-35
  1. Summary of impacts---------------------------------- II-35
  2. Description of the existing environment------------- II-35
  3. Impacts of the proposal----------------------------- II-35
H. Sociology--- II-36
  1. Summary of impacts---------------------------------- II-36
  2. Description of the existing environment------------- II-38
    a. Population-- II-38
    b. Social structure---------------------------------- II-38
    c. Attitudes toward coal development----------------- II-40
    d. Noise--- II-40
    e. Mental health------------------------------------- II-40
    f. Trends-- II-41
  3. Impacts of the proposal----------------------------- II-42
  4. Mitigating measures--------------------------------- II-42
I. Economics--- II-43
  1. Summary of impacts---------------------------------- II-43
  2. Description of the existing environment------------- II-43
    a. Employment and income----------------------------- II-43
    b. External costs------------------------------------ II-45
    c. Fiscal conditions--------------------------------- II-47
  3. Impacts of the proposal----------------------------- II-48
J. Community services------------------------------------ II-51
  1. Summary of impacts---------------------------------- II-51
  2. Description of the existing environment------------- II-51
    a. Housing--- II-51
    b. Water system-------------------------------------- II-51
    c. Waste disposal------------------------------------ II-51
    d. Police protection--------------------------------- II-52
    e. Fire protection----------------------------------- II-52
    f. Library--- II-52
    g. Communication------------------------------------- II-52
    h. Welfare services---------------------------------- II-52
    i. Schools--- II-52
    j. Health facilities--------------------------------- II-53
  3. Impacts of the proposal----------------------------- II-53
K. Land use-- II-54
  1. Summary of impacts---------------------------------- II-54
  2. Description of the existing environment------------- II-54
  3. Impacts of the proposal----------------------------- II-56
L. Transportation-- II-56
  1. Summary of impacts---------------------------------- II-56
  2. Description of the existing environment------------- II-56
    a. Roads--- II-56
    b. Railroads--- II-60
  3. Impacts of the proposal----------------------------- II-60
M. Recreation-- II-60
  1. Summary of impacts---------------------------------- II-60
  2. Description of the existing environment------------- II-61
    a. Urban recreation resources------------------------ II-61
    b. Non-urban recreation resources-------------------- II-61
  3. Impacts of the proposal----------------------------- II-62

- N. Cultural resources-- II-62
  - 1. Summary of impacts------------------------------------- II-62
  - 2. Description of the existing environment------------- II-63
  - 3. Impacts of the proposal---------------------------- II-64
- O. Esthetics--- II-64
  - 1. Summary of impacts------------------------------------- II-64
  - 2. Description of the existing environment------------- II-65
  - 3. Impacts of the proposal---------------------------- II-65

Chapter III. Alternatives to approving the permit as proposed---- III-1
- A. Administrative alternatives------------------------------ III-1
  - 1. Department of State Lands--------------------------- III-1
    - a. No action-- III-1
    - b. Disapprove the permit---------------------------- III-1
    - c. Selective denial---------------------------------- III-3
    - d. Approve the permit with stipulations----------- III-3
  - 2. Department of Health and Environmental Sciences----- III-4
- B. Technological alternatives------------------------------ III-4
  - 1. Alternative mining methods------------------------- III-4
  - 2. Alternative energy sources------------------------- III-5

Chapter IV. Consultation and coordiation------------------------ IV-1
- A. Development of this statement-------------------------- IV-1
- B. Review of this statement-------------------------------- IV-2

Chapter V. References-- V-1

Chapter VI. Appendixes--- VI-1
- B-1.--Spoil water quality at the Rosebud mine---------------- VI-1
- B-2.--Comparison of shallow alluvial ground water quality---- VI-2
- B-3.--Rosebud coal aquifer quality--------------------------- VI-3
- F-1.--Seed mixtures proposed for Area E---------------------- VI-4
- G-1.--Vegetative habitat types------------------------------- VI-6
- I-1.--Disposition of the coal severance tax collection------- VI-8
- I-2.--Summary of the cost to the consumer of the Montana severance tax-- VI-9
- I-3.--Method for calculating the effect of the pending Federal royalty increase------------------------------ VI-10

FIGURES

Fig. I-1.--Location of proposed expansion of Area E-------------- I-2
- I-2.--Sequence of mining at Area E-------------------------- I-3
- I-3.--Bonding levels within the proposed permit area--------- I-4
- I-4.--Surface ownership at Area E--------------------------- I-7
- I-5.--Coal leases held by Western Energy Company at Area E--- I-8

- II-1.--Existing topography at Area E------------------------- II-2
- II-2.--Geologic cross-section across Areas E and B----------- II-4
- II-3.--Proposed postmining topography at Area E-------------- II-6

II-4.--Potentiometric surface of the Rosebud coal seam------- II-11
II-5.--Selected surface water quality measurements in the Colstrip vicinity-- II-17
II-6.--Rosebud County population----------------------------- II-39
II-7.--Transportation routes near Colstrip------------------ II-58

TABLES

I-1.--Annual coal production from Colstrip-area mines-------- I-5

II-1.--Overburden properties significantly exceeding State suspect levels-- II-3
II-2.--Ground water aquifers in the Colstrip area------------- II-12
II-3.--Comparison of water quality in two paired ponds draining Area E-- II-15
II-4.--Size of largest storm expected at Colstrip during various lengths of time------------------------------- II-22
II-5.--Total suspended particulate concentrations at Colstrip- II-24
II-6.--Estimated potential and controlled particulate emissions from Area E---------------------------------- II-26
II-7.--Gaseous emissions (tons/year) from mining at Area E---- II-27
II-8.--Soil resources in proposed disturbance area of section 2 of Area E--- II-29
II-9.--Vegetative communities at Area E---------------------- II-33
II-10.--Comparison of existing and postmining vegetative habitat types-- II-37
II-11.--Employment by broad industry and sector in Rosebud County-- II-44
II-12.--Unemployment rates, 1970-1979------------------------- II-44
II-13.--Per capita personal income, selected years 1950-77---- II-45
II-14.--Personal income in Rosebud County by major sources---- II-46
II-15.--Public revenues generated by Area E, 1980-84---------- II-49
II-16.--Area E coal production by lease, 1980-84-------------- II-50
II-17.--Western Energy land use summary---------------------- II-55
II-18.--Average daily traffic counts for highways near Area E, 1968-1978-- II-59

CHAPTER I

DESCRIPTION OF THE PROPOSAL UNDER CONSIDERATION

A. SCOPE OF ANALYSIS

Western Energy Company has applied to the Montana Department of State Lands (DSL) for a permit to extend Area E of its Rosebud coal mine near Colstrip, Montana into sections 2 and 11, T. 1 N., R. 41 E. (See figs. I-1 and I-2.) Under the provisions of the Montana Strip and Underground Mine Reclamation Act, DSL must approve a mining and reclamation plan (called hereafter the "mine plan") before mining can occur in the proposed area. Western Energy has State and Federal permits for its current Area E operations in sections 1, 2, 3, and 12, T. 1 N., R. 41 E., and sections 34 and 35, T. 2 N., R. 41 E. If the company's proposed mine plan proves acceptable, DSL would amend the existing permit.

The area proposed for mining was examined in an environmental impact statement (EIS) issued by DSL in 1977. Western Energy's current proposal covers a smaller area and is more detailed than its proposal evaluated in the 1977 EIS; in addition, new information on social conditions and the physical environment is available which allows more precise analysis of environmental impacts. For these reasons, DSL has decided to update and supplement the 1977 EIS with this document, which focuses on the extension of the Area E mine into sections 2 and 11, T. 1 N., R. 41 E.

Of the 450 acres included in the permit application, 427 acres have been previously permitted by DSL for use as haul roads, highwall reduction, and other disturbance associated with mining. Western Energy's proposed permit amendment would allow it to mine 276 acres of this area through 1985, the remainder of Area E's life. All of the 427 acres would be bonded for mining-level disturbance, however. The remaining 23 acres of the 450-acre application area, which have not been previously permitted by DSL, would be bonded for associated disturbance. Figure I-2 shows the proposed sequence of mining in Area E; fig. I-3 shows the proposed bonding area. Mining under this application would be confined to section 2. The bonded acreage in section 11 would be used for topsoil storage, haul roads, and a buffer strip.

Average coal production from Area E would be about 3 million tons/year, close to the current average level (table I-1). No new employees would be required at the mine and no new facilities would be built.

Western Energy has applied to the Montana Department of Health and Environmental Sciences (DHES) for an air quality permit for its Rosebud mine. DHES issued a water pollutant discharge permit to Western Energy on March 13, 1980 (permit no. MT-0023965). DSL does not issue air and water quality permits, but can require measures to control fugitive dust and water pollution from mined lands and reclaimed areas.

The Office of Surface Mining, U.S. Department of the Interior, must also approve a mine plan for the proposed area under the Surface Mining Control and Reclamation Act of 1977, but Federal approval is not specifically addressed in this EIS.

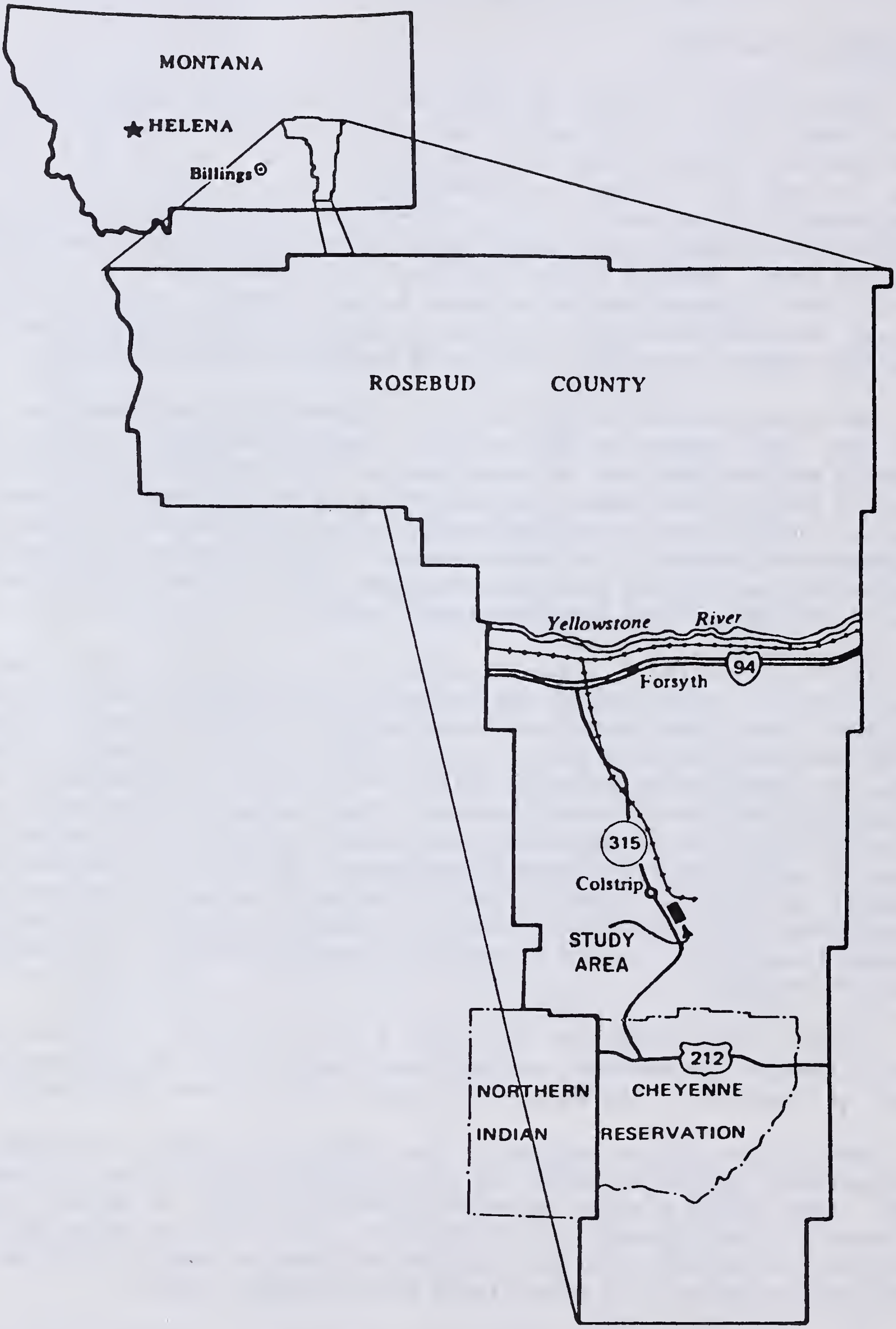


FIGURE I-1.--Location of proposed expansion of Area E ("study area").

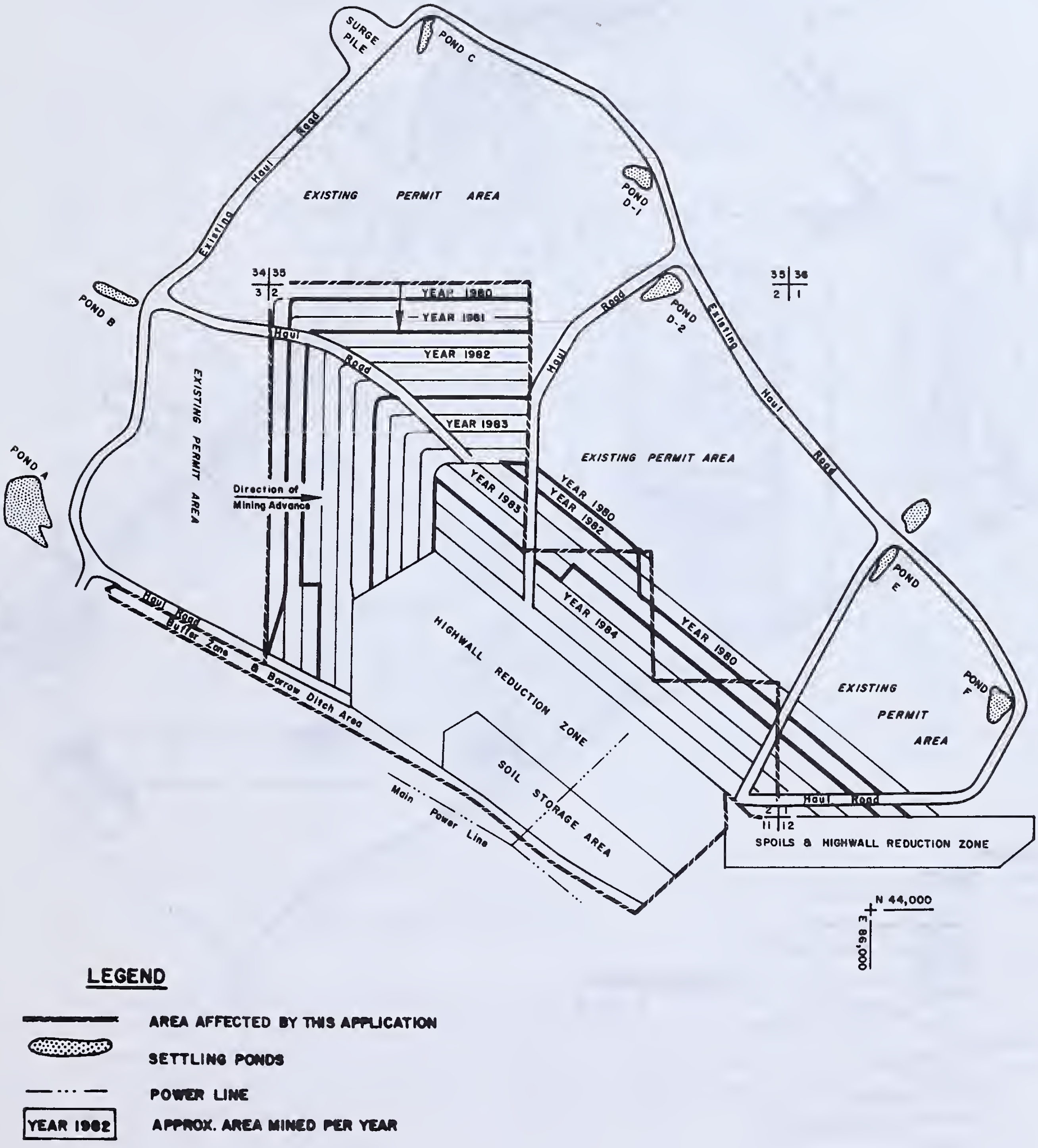


FIGURE I-2.--Sequence of mining at Area E.
Scale: 1 inch equals approx. 1,700 feet.

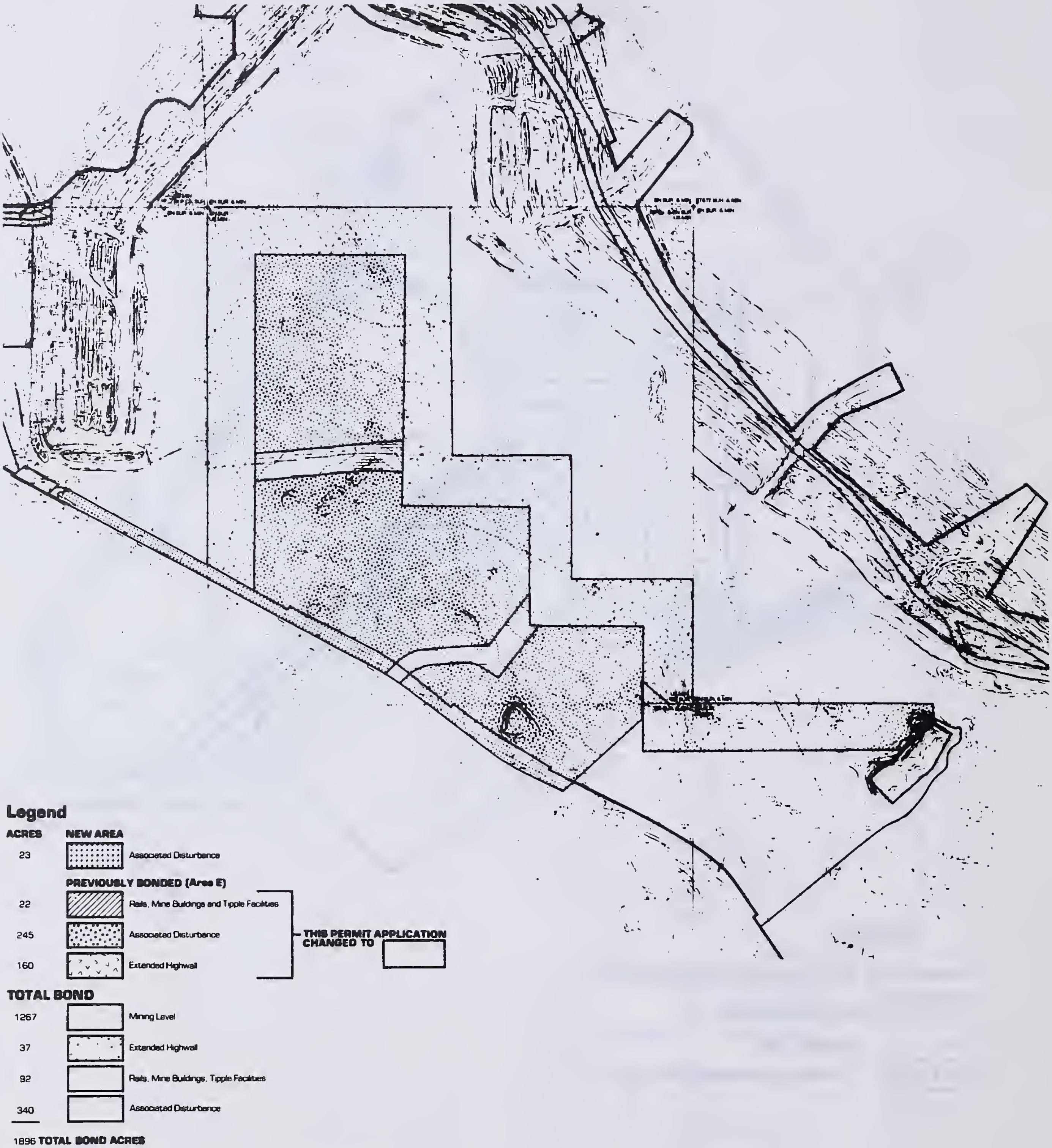

Legend
ACRES
NEW AREA
23 Associated Disturbance
PREVIOUSLY BONDED (Area E)
22 Rails, Mine Buildings and Tipple Facilities
245 Associated Disturbance
160 Extended Highwall
THIS PERMIT APPLICATION CHANGED TO
TOTAL BOND
1267 Mining Level
37 Extended Highwall
92 Rails, Mine Buildings, Tipple Facilities
340 Associated Disturbance
1896 TOTAL BOND ACRES

FIGURE I-3.--Bonding levels within the proposed permit area.

TABLE I-1.--Annual coal production from Colstrip-area mines

[Data are in millions of tons]

	Western Energy Co.			Peabody Coal Co.	
Year	Area E	Other areas	Total	Big Sky	Total
1968	---	0.2	0.2	---	0.2
1969	---	0.5	0.5	0.2	0.7
1970	---	1.7	1.7	1.4	3.1
1971	---	5.2	5.2	1.5	6.7
1972	---	5.5	5.5	1.6	7.1
1973	---	4.3	4.3	2.0	6.3
1974	---	3.2	3.2	2.2	5.4
1975	2.6	3.8	6.4	2.2	8.6
1976	2.4	6.9	9.3	2.4	11.7
1977	2.7	7.1	9.8	2.3	12.1
1978	2.9	7.7	10.6	2.1	12.7
1979	4.1	7.6	11.7	2.5	13.7
1980	5.4	6.6	12.0	3.0	15.0
1981	1.6*	11.3	12.9	3.0	16.5
1982	3.2*	10.3	13.5	4.2	17.7
1983	3.3*	13.7	10.2	4.2	14.4
1984	3.1*	13.9	17.0	4.2	21.2
1985	0	18.0	18.0	4.2	22.2
1986	0	19.1	19.1	4.2	23.3
1987	0	19.1	19.1	4.2	23.3

*Production under this application.

The Rosebud mine was discussed in volumes 1 and 3 of FES 80-1, a regional analysis of coal development in the northern Powder River basin (U.S. Department of the Interior and Montana Department of State Lands, 1980). FES 80-1 provides an overview of the cumulative impacts of mining and electric power generation in the Colstrip area, to which Area E of the Rosebud mine contributes.

B. MINE HISTORY

Part of Area E was mined by the Northern Pacific Railroad from 1925 through 1945, before Western Energy acquired the Rosebud mine. The coal was used for steam locomotives and domestic purposes. Western Energy began mining coal from Area E in 1975 under permit 73003 issued by DSL in December, 1973. Western Energy sold the coal to its parent company, Montana Power, for use at the Corette electric generating plant in Billings. The Department issued permits to expand Area E in 1975, 1976, and 1977. The latter permit (77003-A001) was issued for a 5-year period and was the subject of an EIS (Montana Department of State Lands, 1977). The Department approved amendments to permit 77003 in 1978 (for an equipment corridor) and 1979 (to widen the equipment corridor). The application now under consideration would further amend permit 77003 to allow expanded mining in Area E.

C. WESTERN ENERGY COMPANY'S PROPOSAL

1. Summary

Western Energy's Area E mine is in southwestern Rosebud County, Montana, about 1 mile southeast of the town of Colstrip (fig. I-1). Coal from Area E is hauled an average of 1-1/2 miles to the Area E coal handling facilities (shown as the "surge pile" in fig. I-2). Coal from Area E is either stockpiled for use in units 1 and 2 or shipped to meet contracts with utility customers. Western Energy sells 680,000 tons/year to Montana Power Company's Corette generating plant in Billings, Mont., and 2,500,000 tons/year to Montana Power's and Puget Sound Power and Light's Colstrip generating units 1 and 2.

The land surface under consideration in this permit amendment application is leased to Western Energy by Burlington Northern, Inc. (fig. I-4). The coal to be mined is Federally owned. Western Energy obtained the Federal coal lease for section 2, T. 1 N., R. 41 E. in 1975 (Billings 02989-07087) and in 1979 (#M35735).

The proposed mine area contains 11.2 million tons of economically recoverable coal in the Rosebud seam. Those reserves would be mined through 1985 at an average annual rate of 3 million tons/year (table I-1). Mining in Area E would be completed in 1984.

Of the six coal seams underlying the proposed mining area, only the uppermost two, the Rosebud and the underlying McKay, are of economic importance. Western Energy mines only the Rosebud seam. Western Energy has not found a market for McKay coal, which has a higher sulfur content than the Rosebud coal and has a tendency to form slag in some steam boilers.

2. Facilities

Western Energy does not propose to build new facilities for the Area E extension. Existing facilities include:

- A 0.1-mile access road to highway FAP 39.
- A 2.2-mile railroad track.

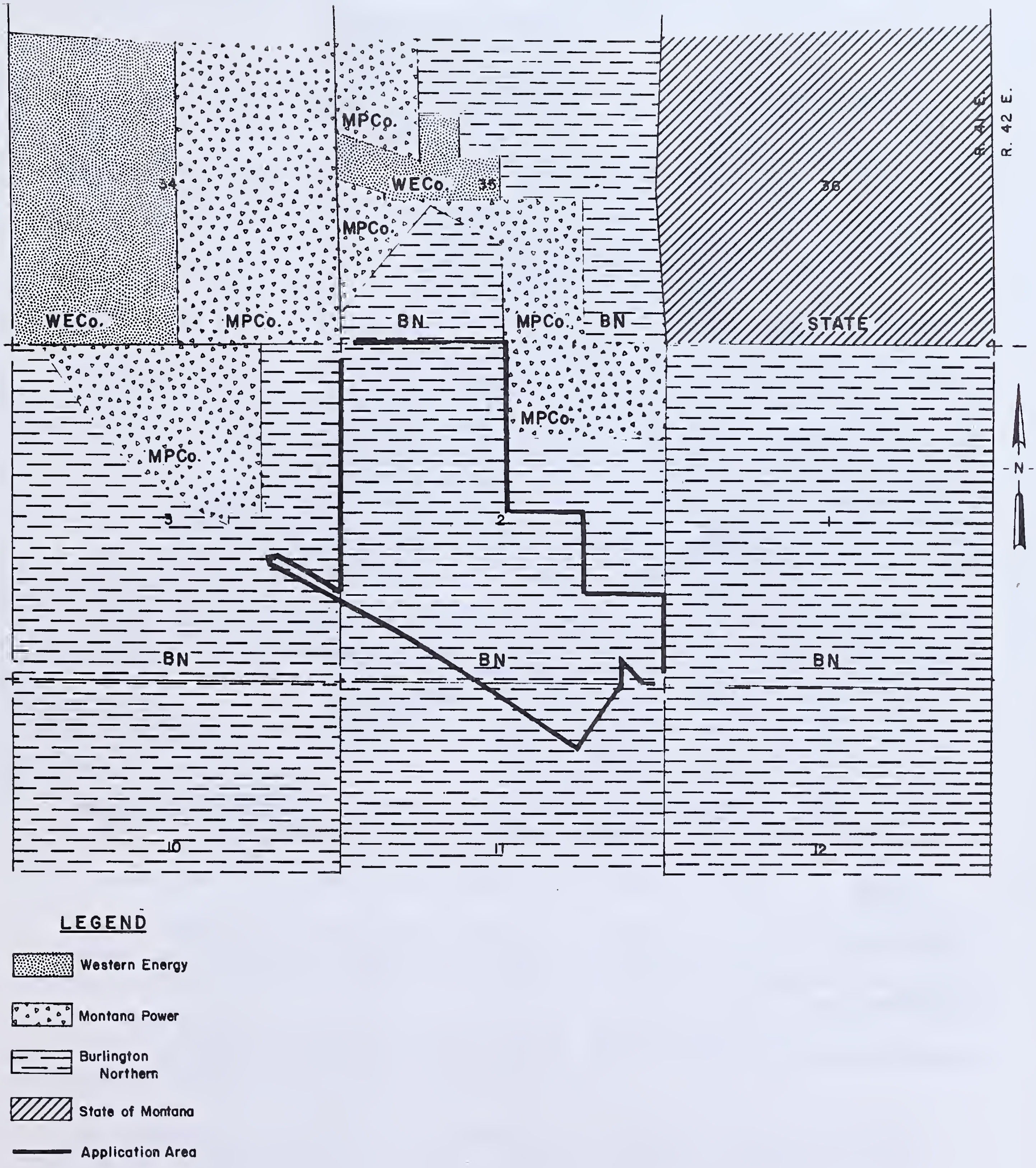


FIGURE I-4.--Surface ownership at Area E.

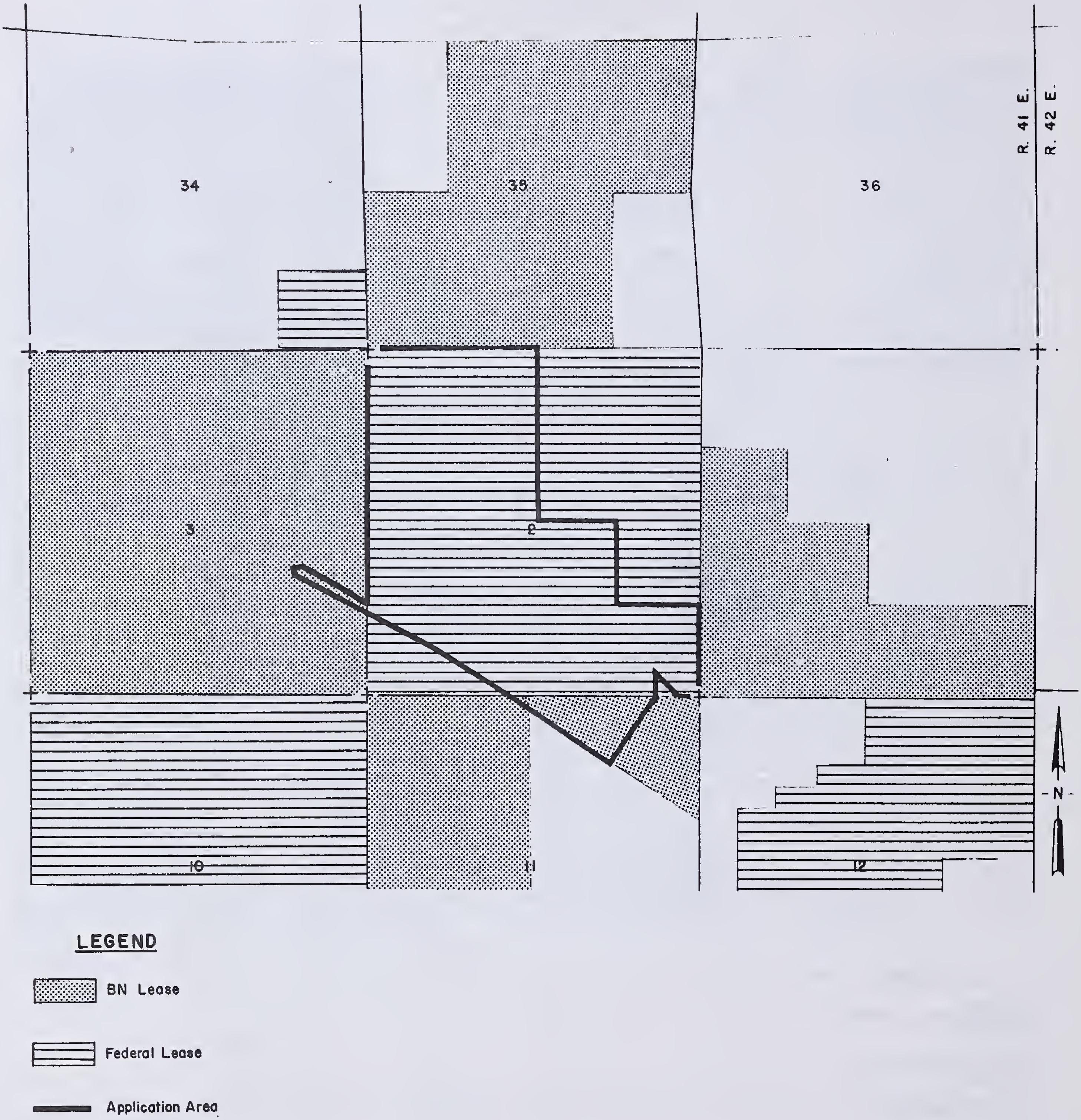


FIGURE I-5.--Coal leases held by Western Energy Company at Area E.

- Several steel-framed structures, a maintenance shop, change rooms, and bath facilities.
- Fuel tanks and explosive storage facilities.
- Coal-handling facilities: primary and secondary crusher, coal surge pile, and tipple loadout with weighing stations.
- Existing haul roads with new extensions into the pit.
- A 12.5 kV and 4.16 kV powerline.
- Portable substations to provide power to equipment in the pit.

3. Mining Plan

Western Energy's submittal covers a 4-year mining plan for the proposed area, at which time mining in Area E will be completed. The anticipated mine life also includes 3 years to establish stable seeded areas and postmining monitoring areas, and 10 years of management to bond release, for a total of 17 years. A total of 420 acres out of the 450-acre permit area would be disturbed during this time: 276 acres of mining, 100 acres of highwall reduction area, 10 acres of topsoil storage area, and 34 acres in the spoil and highwall reduction zone. An additional 30 acres that are too steep to mine would remain undisturbed.

Western Energy will extract the coal using the area surface mining method. This mining method is used in all of its operations at Colstrip. The first dragline pass will be a continuation of the existing Area E mining operations. Successive passes will be made parallel to the first pass so that mining will advance in the direction indicated by the arrows in figure I-2.

Topsoil and subsoil will be stripped for the mining area in advance of each pass in two separate lifts. Average depth of topsoil stripped will be 6 to 8 inches. This will be accomplished by scrapers which will strip, transport, and deposit the topsoil on regraded areas.

After topsoil has been removed from a sufficient area, subsoil will be removed to an average depth of 2.5 feet. Overburden will then be stripped using a dragline, assisted at times with mobile diesel equipment.

The overburden removed from the current pass will be cast into the empty pit remaining from the preceding pass. This overburden will then be regraded to the approximate original contour.

As the Rosebud coal seam is exposed in each pass, the coal will be excavated by loading shovels or mobile diesel equipment. These machines will load the coal into coal haulers. These haulers will transport the coal to the existing handling facilties.

The final cut will be backfilled and regraded to slopes no greater than 5:1 (20 percent) with material from the highwall reduction zone.

4. Reclamation Plan

The reclamation program will include at a minimum: topsoil and subsoil salvaging, backfilling, regrading, highwall reduction, drainage reconstruction, topsoil and subsoil redistribution, revegetation, and monitoring. Western Energy will plant native grass mixtures, and interseed and transplant forbs, shrubs, and trees at a frequency similar to that which existed before mining. After being reclaimed, Area E would be used for livestock grazing and wildlife habitat.

Additional detail concerning Western Energy's reclamation plan, including postmining topography, soil salvage depths, and seed mixtures, is found in chapter II, Appendix F-1, and in the company's permit application which is on file with the Department of State Lands.

CHAPTER II

ANALYSIS OF WESTERN ENERGY COMPANY'S PROPOSAL

A. GEOLOGY

1. Summary of Impacts

Impacts on topography and geomorphology would not be significant because the company's proposed mine plan would minimize erosion over the long term. Erosion on the reclaimed minesite would at first be higher than on most native range lands near Colstrip, but erosion rates are expected to approach premining levels within 3-4 years after revegetation.

2. Description of the Existing Environment

a. Topography and geomorphology

The topography and geomorphic setting of Area E is typical of southeastern Montana. The unmined portion of Area E is higher than the adjacent landscape (fig. II-1). The ridge running roughly north-south through Area E acts as a drainage divide between East Fork Armells Creek on the west and Cow Creek, tributary to Rosebud Creek, on the east. Half of the proposed permit area drains into East Fork Armells Creek and half drains into Cow Creek. Small ephemeral drainages start near the ridgetop crest, in middle of the unmined portion of Area E, and drain the area in both directions. The topographic relief from the top of the rolling ridge to the nearby lowlands is about 200 feet.

Because the native rangeland in Area E is in fair to good condition, erosion rates are probably moderate to low. Empirical measurements of erosion in the area are lacking. Western Energy has proposed to study erosion rates on both native rangeland and mine reclamation areas. The company is required to implement such a study in order to gauge if they have successfully reclaimed the mine areas for bond release purposes; the reclaimed landscape must be as erosion resistant as the premining landscape before bond can be released. Western Energy has begun a baseline erosion study, but DSL may require changes in the study in order to standardize such studies from one mine to another.

b. Overburden

Previous overburden sampling in Area E (Montana Department of State Lands, 1977) did not cover the area to be mined. Additional overburden test cores were taken from eight locations in the proposed mining area for this permit application. The test holes were located 1000 feet apart, although DSL guidelines only require that they be 2000 feet apart. Table II-1 shows which elements in the eight samples exceed State suspect levels. The indicated suspect levels suggest that reclamation and postmining land use may be affected if spoils with those properties are moved near the surface (see section 3, Impacts of the Proposal).

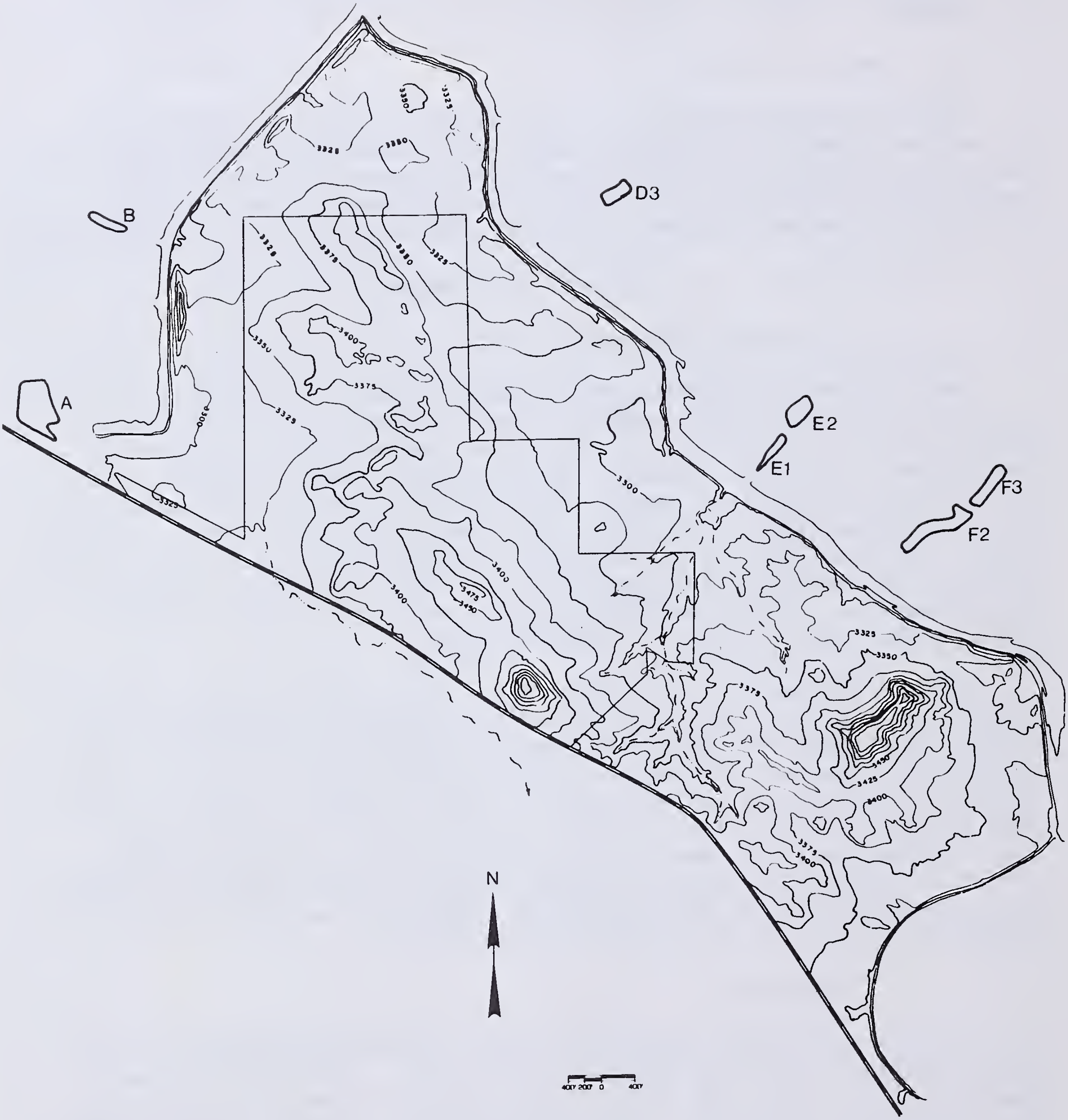


FIGURE II-1.--Existing topography at Area E.

TABLE II-1.--Overburden properties significantly exceeding State suspect levels

Core hole	Location	Property	Length of affected core	% total core	Observed value ($\overline{X}$)	State suspect level
	Section 2, T.1 N., R.41 E.					
N46-E64	SE1/4 SE1/4	Molybdenum	90'	69%	0.44 ppm	>0.30 ppm
N47-E62	NE1/4 SW1/4	Molybdenum	65'	32%	0.50 ppm	>0.30 ppm
N47-E63	NW1/4 SE1/4	Molybdenum	85'	53%	0.61 ppm	>0.30 ppm
N48-E61	S1/2 NW1/4	Molybdenum	55'	33%	0.49 ppm	>0.30 ppm
N48-E62	SE1/4 NW1/4	Molybdenum	120'	57%	0.65 ppm	>0.30 ppm
N49-E61	Center NW1/4	Molybdenum	200'	98%	0.66 ppm	>0.30 ppm
		Manganese	35'	17%	83.9 ppm	>60.0 ppm
		Nickel	50'	24%	1.58 ppm	>1.00 ppm
N49-E62	E1/2 NW1/4	Molybdenum	110'	63%	0.47 ppm	>0.30 ppm
N50-E61	N1/2 NW 1/4	Molybdenum	180'	88%	0.43 ppm	>0.30 ppm

c. Stratigraphy and structure

The Colstrip area is at the northern end of the Powder River basin, a broad, shallow syncline (trough) between the Big Horn Uplift to the west, the Black Hills Uplift to the east, and the Porcupine Uplift to the north. The ancient Powder River basin is filled with several thousand feet of sedimentary strata dating from 600 million years ago to relatively recent deposits. Erosion has removed much of the younger strata exposing the Tongue River Member of the Fort Union Formation. This unit, comprising interbedded sandstone, siltstone, coal, and shale, has a maximum thickness in the Colstrip area of about 450 feet (Montana Department of State Lands, 1977). The Tongue River Member has 6 prominent coal seams remaining; only the top two, the Rosebud and McKay (fig. II-2), are currently economically feasible to mine. The Rosebud seam averages 24 feet thick; the McKay, 8 to 10 feet thick. The interburden that separates the seams in Area E varies in thickness from 12 to 22 feet, averaging near 17 feet.

The McKay coal seam at the Rosebud mine is not being mined because Western Energy has not been able to find a market for the coal. The McKay coal has more sulfur and lower BTU value than the Rosebud coal (see

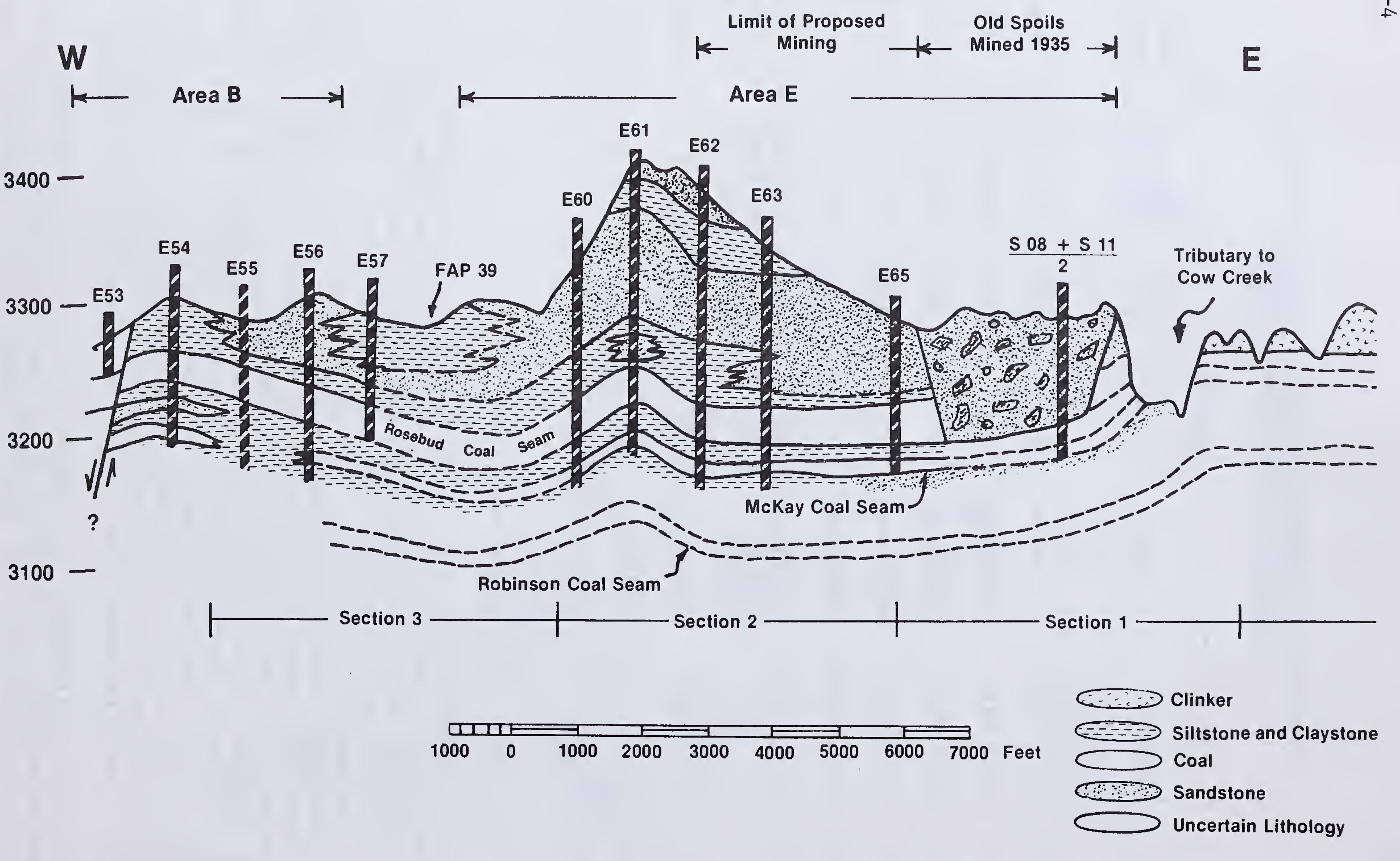


FIGURE II-2.--Geologic cross-section across Areas E and B (due east-west at N47,000--approximately the center of sections 1, 2, and 3, T. 1 N., R. 41 E.). Solid lines show known contact; dashed lines show inferred contact.

chapter III, Technological Alternatives). The Rosebud coal averages 8,600 BTU as received and .7 percent sulfur (Western Energy Company, written commun., March 7, 1980).

The Rosebud overburden and the Rosebud-McKay interburden in the Colstrip area is composed of variable amounts of sandstones, siltstones, and shales (fig. II-2). These units often are not distinct, but blend into one another laterally and vertically.

The geologic history and structural setting of the Powder River basin and the Colstrip region is summarized in Dollhopf and others (1978b); therefore, only the site-specific structural setting is discussed here. The top of the Rosebud coal seam at the Rosebud mine has an undulating surface with localized troughs (synclines) and ridges (anticlines)(fig. II-2). The axis of these features generally is oriented northwest-southeast. The ridges have locally fractured the coal seams, allowing the coal to transmit more ground water than is naturally the case (see Hydrology).

3. Impacts of the Proposal

a. Topography and geomorphology

With proper management, Area E would be as geomorphically stable after reclamation as before mining. This is so because the regraded land surface would closely approximate the premining landscape (see fig. II-3).

Until the area has been revegetated (a few years after mining), erosion rates may be fairly high; however, ponds would capture most of the eroded sediment and prevent it from reaching streams off the minesite. If revegetation succeeds and postmining land management practices foster a good vegetative cover (this appears likely--see Vegetation), then erosion rates at Area E would probably be less than before mining. The company would not be allowed to remove the sediment ponds until it demonstrated that erosion rates were no higher than before mining; therefore, the amount of sediment reaching offsite streams would be no greater than before mining.

Western Energy proposes five measures to help control erosion on Area E: the landscape will be shaped into a complex slope configuration; all slope angles will be 20 percent or less; a relatively dense network of drainages similar to the premining drainage network will be constructed; topsoil will be placed along topographic contours rather than up and down slopes; 1-1/2 to 2 tons/acre of straw mulch or 1 ton/acre of wood fiber will be applied to freshly topsoiled areas on slopes greater than 10 percent. As described below, these steps would provide a good setting for vegetative establishment.

Complex slopes (convex at the top, straight along the middle and concave or dish-shaped at the base) have been shown to be less erosive than long uniform or convex slopes (Wischmeier and Meyer, 1973). Runoff does not gain as much momentum near the top, so the slope can be steeper.

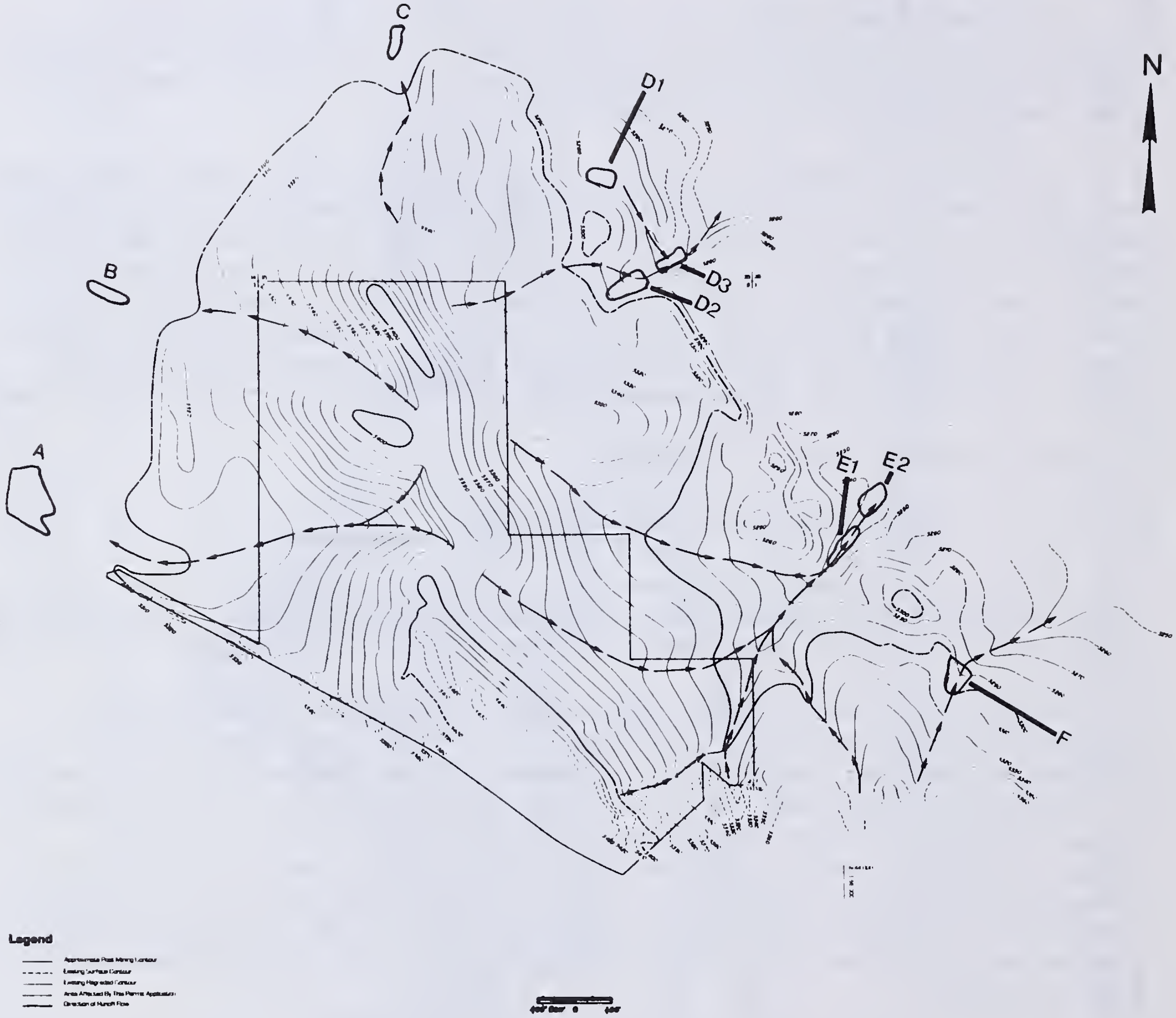

C
D1
N
B
D3
D2
A
E1
E2
F
Legend
Approximate Post Mining Contour
Existing Surface Contour
Existing Regraded Contour
Area Affected By This Permit Application
Direction of Runoff Flow

FIGURE II-3.--Proposed postmining topography at Area E. Contour interval is 10 feet.

By straightening and gradually flattening the slope along the lower portion, the velocity of runoff is reduced, decreasing erosion. Figure IV-1 in the draft EIS on Area B (Montana Department of State Lands, 1980) shows complex slopes in cross-section.

All slope angles on the reclaimed topography of Area E would be less than 20 percent, with the average much less than 20 percent. Slopes steeper than 20 percent are susceptible to accelerated erosion. Slope gradients would closely approximate premining drainage gradients. Some small (1-2 feet deep) gullies would probably develop in reclaimed drainages because existing drainages in Area E have small gullies. The company would be required to implement control measures if gullies over 9 inches developed. Those measures could include filling the gullies with soil, replanting, and placing straw bales to reduce runoff velocity.

By constructing a relatively dense network of drainages, the length of the hill slopes of Area E would be shorter. Shortening the slope lengths reduces the area which would be subject to excessive overland runoff flow. Runoff would be directed towards drainages that are better suited for faster and higher flow conditions.

Topsoiling on contours rather than working the topsoil either up or down slope creates surface irregularities (i.e. tire compaction and farm equipment traces) that are perpendicular to runoff flows. This increases infiltration, reduces flow velocities, and prevents concentration of runoff.

Straw mulching of the freshly topsoiled reclaimed areas would reduce erosion by: 1) increasing the amount of precipitation that infiltrates into the ground, 2) increasing the soil roughness, reducing overland flow velocities and, 3) lightening the color of the landscape surface which lowers the evaporation loss of soil moisture (reducing heat buildup).

b. Impacts of overburden constituents

Slightly elevated molybdenum (Mo) levels throughout the proposed mining area (table II-1) are a potential problem. The increase in Mo levels would not affect the success of revegetation; however, Erdman and others (1978) associated increased Mo with reduced copper (Cu) to Mo ratios in plant tissue, especially in sweet clover. Ruminants grazing on vegetation with a low (narrow) Cu:Mo ratio would be susceptible to molybdenosis, a copper-deficiency disease that occurs particularly in young calves and sheep. The physiological availability of Cu in the animal is depressed due to the effect of elevated Mo levels. (Dollahite and others, 1972).

A relationship has not yet been found between the Cu:Mo ratio in overburden or soil and that found in associated plant tissue. Assuming that a similar Cu:Mo ratio would be found in the reestablished vegetation as is found in the overburden material, molybdenosis is not likely to occur because the Cu:Mo ratio in the overburden appears to be high (wide) enough to reduce the impacts in most of the proposed mining area. In addition, legumes appear to accumulate Mo much more than other plants (Kubota, 1975), and, based on the proposed seed mixture, legumes are not expected to be present in significant amounts in the reclaimed vegetative communities. The company plans to replace topsoil and subsoil over the disturbed area prior to revegetation. This will further prevent problem levels of Mo from occurring in the vegetation.

Manganese (Mn) levels in portions of core N49-E61 exceed State suspect levels. Because the pH levels of the overburden in the proposed mining area are mostly between 7.0 and 8.5, Mn toxicity in the reestablished vegetation would probably not occur. Mn is not readily taken up by plants at pH levels of 6.4 and greater (Tisdale and Nelson, 1975). In addition, Dollhopf and others (1978a) report that when the problem material constitutes less than 5 percent of the total overburden volume (as in the case here), such material is essentially undetectable in the spoil pile because of the mixing that occurs during mining.

Nickel (Ni) levels in portions of the same test core (N49-E61) slightly exceed the State suspect level. Ni has been reported to be potentially toxic to some plant species at relatively low concentrations (Sauchelli, 1969); however, the suspect level appears to be conservative. The Ni concentration given in table II-1 constitues less than 5 percent of the total overburden material; therefore, as with manganese, mixing of the overburden during mining would dilute the Ni to essentially undetectable levels. Because of this mixing, and because the suspect level is conservative, no problems are anticipated regarding plant toxicity from nickel.

Analysis of the overburden for other chemical properties demonstrated considerable variability within every test core; however, only small amounts of core material in isolated pockets approached or exceeded State suspect levels. These isolated pockets of potentially toxic materials would be diluted considerably during mining and therefore are not expected to adversely affect reclamation or postmining land use.

B. HYDROLOGY

1. Summary of Impacts

Hydrologic impacts from the Area E extension could be significant, because continued mining in Area E could add additional saline waters to the headwaters of Cow Creek. This could slightly reduce the productivity of irrigated fields and native rangeland east of Area E. Existing data strongly suggest that excessive salts from current and previous mining are reaching surface waters, but the data are insufficient to prove significant degradation. Additional studies could be undertaken to refine these tentative predictions of hydrologic impacts and determine their significance.

2. Description of the Existing Environment

a. Surface drainage and use

The north-south ridge within Area E (fig. II-1) is a drainage divide between East Fork Armells Creek and Cow Creek. Because Area E encompasses only headwater tributaries to those streams, runoff is normally very small and sporadic, occuring only in response to snowmelt and intense rainstorms.

Cow Creek could be more affected by mining in Area E than East Fork Armells Creek for the following reasons: 1) approximately two-thirds of the area to be mined drains into Cow Creek; 2) the drainage area of Cow Creek and South Fork Cow Creek is about half that of East Fork Armells Creek and therefore the mine area constitutes a greater percentage of its drainage area; 3) ground water in the bedrock units below the level of mining--the Rosebud-McKay interburden and the McKay coal seam--flows to the east, towards Cow Creek. Because of this, the ensuing discussion emphasizes the Cow Creek drainage.

Cow Creek appears to meet the criteria for alluvial valley floors (AVF) set forth in the Montana Strip and Underground Mine Reclamation Act: it is underlain by alluvial deposits and appears to be flood irrigated. Additional studies of surface and ground waters east of Area E would be necessary to determine whether Cow Creek is an AVF and whether continued mining of Area E would adversely affect the potential AVF area.

Cow Creek is used for livestock watering, and irrigation of alfalfa and native range hay meadows. Wildlife also use these waters. The nonirrigated native range along the creek benefits from surface water recharge of the shallow alluvial aquifer and from natural flood irrigation during high runoff.

Fifty acres of alfalfa are planted along the flood plain of Cow Creek immediately northeast of the area proposed for mining. Two miles farther downstream, earthen spreader dikes back up flood flows of Cow Creek and spread water onto roughly 100 acres of alfalfa (Bailey Egan, oral commun., August, 1980). Downstream on Cow Creek the Kluver ranch has a few old spreader dikes that aid in the occasional flood irrigation of native rangeland, primarily during high runoff (Patty Kluver, oral commun., August 19, 1980).

b. Aquifers

The natural ground water system in Colstrip contains three predominant aquifers and two other geologic units that intermittantly act as aquifers. The predominant aquifers are the Rosebud and McKay coal seams, and the shallow alluvial ground water system of East Fork Armells Creek (Montana Department of State Lands, 1977)(fig. II-2). The Rosebud and McKay aquifers are normally utilized for domestic and agricultural water only when they lie within 200 feet of the surface (Van Voast and others, 1977). Intermittent aquifers are found in sandstone units within the Rosebud overburden, the Rosebud-McKay interburden (between the coal seams) and in deeper bedrock units. In the mine area another aquifer has formed at the base of the spoils (Dollhopf and others, 1979b).

1) Coal seam aquifers

The Rosebud aquifer is a major target of ground water wells within this region, especially for stock watering. It averages about 24 feet thick in Area E (Montana Department of State Lands, 1977). Mineralization of water within the Rosebud aquifer averages just over 1,400 milligrams per liter (mg/l) total dissolved solids (TDS) upgradient of Area E (Van Voast and others, 1977; Dollhopf and others, 1978c). (Total dissolved solids are an indication of the mineralization and salinity of water.) Ground water in the Colstrip area often exceeds the drinking water standards set by the U.S. Public Health Service (1000 mg/l maximum). Most ground water in eastern Montana exceeds that level.

The Rosebud aquifer and most of the bedrock aquifers within 200 feet of the surface flow primarily to the east (fig. II-4). The flow pattern is controlled by the gradient, transmissivity, and outcrop geometry of the aquifer (Van Voast and others, 1977). The Rosebud aquifer is recharged with water from areas upgradient of Area E, mainly to the west. The Rosebud aquifer and East Fork Armells Creek alluvium recharge and discharge to each other, depending on which aquifer exerts higher pressures.

The Rosebud coal seam probably transmits about 2 to 3 gallons per minute (gpm) in Area E (Western Energy permit application; Van Voast and others, 1977). This amount would probably be higher were it not for mining upgradient in Area B, which is intercepting the same aquifer. Higher transmissivity is expected because of small folds in Area E which have fractured the coal (see Geology, stratigraphy and structure section). After Area B is reclaimed, the Rosebud coal seam would transmit more water through Area E than at present.

The McKay coal aquifer averages 8 to 10 feet thick, generally flows to the east, and transmits about 1-1/2 gpm in Area E--similar flow as in the overlying Rosebud aquifer (Van Voast and others, 1977). Water in the McKay coal aquifer near Colstrip has been degraded by seepage from the Montana Power Company ponds east of Area E (Botz, 1978; table II-2). Ground water in the Rosebud coal seam downgradient of Area E appears to be of lesser quality than upgradient of Area E, suggesting that poor quality water is seeping from the mine area (see table II-2).

2) Alluvial aquifer

The other aquifer extensively used as a source of ground water in the Colstrip area is the East Fork Armells Creek alluvium. It is 30-40 feet thick and is composed of gravel overlain by clay. The gravel transmits water at about 50 gpm (Van Voast and others, 1977). Total dissolved

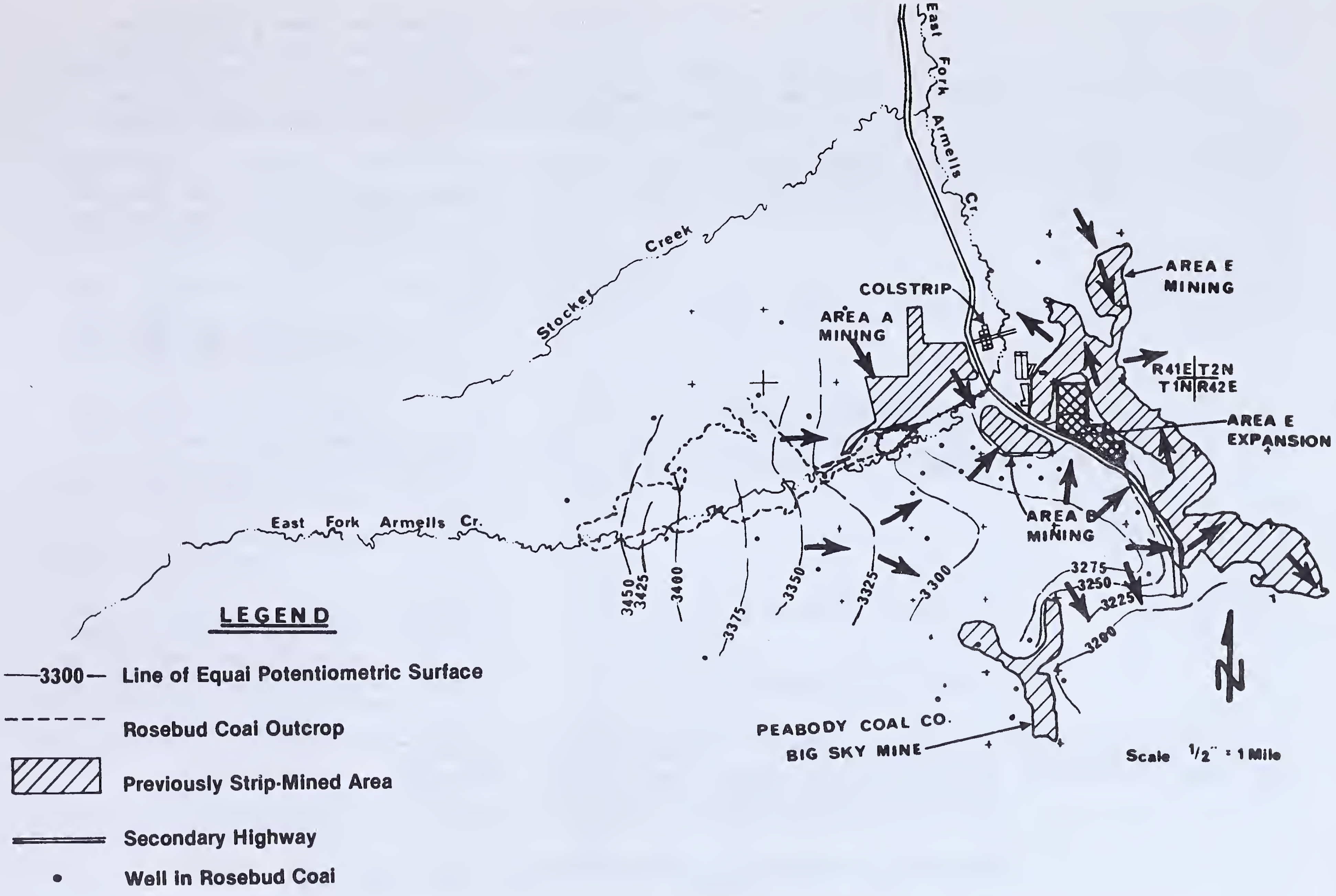


FIGURE II-4.--Potentiometric surface of the Rosebud coal seam. Arrows show direction of ground water flow in the Rosebud coal and in mine spoils (area of diagonal rules).

TABLE II-2.--Ground water aquifers in the Colstrip area

Aquifer	Thickness (Feet)	No. Sample Sites	No. Samples	Range of Water Quality Total Dissolved Solids mg/l (average)	Average Flow Rate (gpm) Colstrip Area	Area E
E. Fork Armells Creek gravels						
--1 mile upstream of Colstrip	23-26	5	6	1,990-(2,326)-2,600	About 50	---
--1 1/2 miles downstream of Colstrip (Van Voast and others, 1977)	20-50	2	3	2,900-(2,930)-2,990	11	---
Rosebud overburden						
Dollhopf and others (1978a)	variable	7	7	345-(1,309)-2,936	.05-1.3/1000'	.5 to 14
Rosebud coal seam						
Van Voast and others (1977)[1]	24	17	24	636-(1,400)-2,988[a]	<.26/1000'	2-3
Dollhopf and others (1978a)[1]	24	10	10	636-(1,315)-2,466[a]	<2.6/1000'	---
WECo Hydrology File (1980)				2,250-(3,586)-4,530[b]		
Rosebud-McKay interburden						
Van Voast and others (1977)		1	1	2,520	---	---
Botz (1978)[2]		4		2,574-(4,517)-6,981	4.5/1000'	28
Area E application	12(17)22					
McKay coal seam						
Dollhopf and others (1978a)		2	2	1,269-(1,390)-1,512	---	---
Van Voast and others (1977)[1]	8-10	5	11	728-(1,659)-2,410	.14/1000'	1.5
Botz, 1978[2]		9		822-(2,004)-3,558	.85/1000'	9

[1] Water quality data only from areas potentially upgradient of Area E.

[2] Water quality may be affected by several Montana Power Company ponds used for generating units 1 and 2. TDS levels in some of those ponds exceeds 10,000 mg/l.

[a] Rosebud coal seam upgradient of Area E.

[b] Rosebud coal seam downgradient of Area E.

solids (TDS) in East Fork Armells Creek gravels average about 2,200 mg/l 1 mile upstream from Colstrip, and over 2,900 mg/l 1-1/2 miles downstream from Colstrip (Van Voast and others, 1977). Discharge from the power generating units, the community sewage treatment plant, lawn watering, and seepage from mine spoils and impoundments probably accounts for the decrease in water quality downstream. Seepage from Area E probably contributes at most only slightly to the total discharge of TDS (mostly salts) affecting East Fork Armells Creek alluvium.

3) Other aquifers

Sandstone within the Rosebud overburden, the Rosebud-McKay interburden, and below the McKay seam varies greatly in thickness, size, and location (fig. II-2). Lateral and vertical variation in lithology of the overburden and interburden, which controls the movement of ground water through the sandstone, makes it hard to determine the amount and location of ground water (Dollhopf and others, 1978a). Based on two wells drilled by Western Energy in adjacent Area B, the estimated flow rate in Area E within the overburden ranges from less than 1 gpm to as high as 14 gpm. Total dissolved solids in overburden in the Colstrip area ranges from 345 to 3,098 mg/l, averaging 1,753 mg/l (table II-2).

The thickness of the Rosebud-McKay interburden varies from 12 feet in the eastern part of Area E to 22 feet in the western part; the average thickness is 17 feet. Sandstone within the interburden, though less common than siltstone and claystone, provides a means of communication between the McKay aquifer and the overlying Rosebud aquifer (Botz, 1978; Dollhopf and others, 1978a). The calculated rate of flow in Area E interburden is 28 gpm (table II-2). This is probably high because the wells used to estimate the flow rate were most likely located along the axis of an inferred fold (fig. II-2).

Water quality within the Rosebud-McKay interburden varies considerably, from about 2,500 mg/l to 7,000 mg/l TDS (table II-2). The interburden appears to be influenced by the industrial ponds near the Colstrip generating units, one of which has TDS levels over 10,000 mg/l. The natural water quality of the interburden would probably be closer to 2,500 mg/l (Van Voast and others, 1977).

The Rosebud coal aquifer, the Rosebud-McKay interburden, and the McKay coal aquifer appear to be hydrologically connected in places (Botz, 1978). The McKay coal aquifer is artesian, but the water levels are lower than the Rosebud, suggesting possible downward recharge (Dollhopf and others, 1979a). Where the Rosebud-McKay interburden is thin or sandy, the amount of ground water passing into the McKay would be greater (Dollhopf and others, 1978a). Because of the potential hydrologic intercommunication between the various strata, impacts on the Rosebud coal aquifer could affect the lower aquifers.

c. Influence of existing mining

Past and current mining is affecting the hydrologic balance of Area E. Constant seepage of very poor quality mine water into the ephemeral tributaries of Cow Creek may be increasing the salinity of its surface waters. A decrease in the quality of ground water that eventually reaches the surface may also be occurring because of mining. The following discussion is based largely on new data that were not available when the previous EIS on Areas A and E was written (1977). Those data, although incomplete, allow a tentative prediction of hydrologic impacts from Area E. Additional studies with greater statistical validity and longer duration could be undertaken to better determine the effect of mining at Colstrip on surface and ground waters.

1) Seepage from impoundments

The primary identified sources of seepage in Area E are seven impoundments created to receive all normal surface water runoff from Area E and ground water collected in the mine pit. Two of the seven impoundments drain into East Fork Armells Creek; five drain into Cow Creek via three channelized ditches (fig. II-1). These impoundments prevent excessive sediment from reaching Cow Creek and East Fork Armells Creek. Water collected in the impoundments is lost through evaporation, seepage, or watering haul roads.

Water is occasionally pumped from the mine pit to the upstream ponds of the two paired ponds in the southeastern spoils area of Area E (labeled ponds E1 and F2 on fig. II-1). These upstream impoundments appear to seep water into two ponds located downstream and to the east. As water passes through the impoundments, its quality progressively decreases (table II-3). Average total dissolved solids (TDS) in the upstream ponds was 2,570 mg/l (pond E1) and 3,156 mg/l (pond F2). The lower ponds averaged 4,155 mg/l (pond E2) and 4,370 mg/l (pond F3)--significantly more mineralized. The water becomes more mineralized in the lower ponds, probably through evaporation and through contact with mine spoils beneath the ponds. Water seeping from the lower ponds would become still more mineralized from additional contact with spoils and through evaporation as it surfaced. Assuming a similar change in water quality from the lower ponds to the surface- and shallow ground waters east of the ponds as found between the ponds, total dissolved solids would probably range from 5,000 to 6,000 mg/l. Water of this poor quality could reduce agricultural productivity downstream, depending on the quantity of seepage.

Seepage from each pond could be as much as a few gallons/minute (gpm). (A garden hose could put out about 5 gpm under good water pressure.) The ponds are losing enough water to maintain marshy and pooled water in three channelized ditches below the southeastern ponds. From estimates of the average annual discharge of Cow Creek in the Colstrip area made by the Montana Bureau of Mines and Geology, the calculated average annual flow entering the impoundments within the Cow Creek drainage would be

TABLE II-3.--Comparison of water quality in two paired ponds draining Area E

[Data are in mg/l total dissolved solids]

	Upstream Pond	Downstream Pond	Agency
Ponds E1-E2			
September 18, 1979	3,583	4,495	Montana Water Quality Bureau
November 1979	1,556	3,815	U.S. Office of Surface Mining
Average	2,570	4,155	
Ponds F2-F3			
September 18, 1979	2,925	4,959	Montana Water Quality Bureau
November 1979	3,386	3,665	U.S. Office of Surface Mining
Average	3,156	4,312	

about 7.5 gpm--proportioned to the three impoundment groups--and about 9 gpm to East Fork Armells Creek (Van Voast and others, 1977). Ground water intercepted by the mine pit and pumped to the ponds would add another 3-17 gpm (table II-2). The contribution to each pond is not known, but assuming equal distribution, each pond in the Cow Creek drainage receives 3-10 gpm. Evaporation could consume up to 1 gpm at each pond, and more would be lost through seepage to underlying strata. If as little as 1-2 gpm were seeping through to surface waters, approximately 1 million gallons/year of very poor quality water (high salinity) could be contributed to each of the three channelized ditches that lead into the headwaters of Cow Creek. That amount of seepage would be significant during low flows but would be insignificant during moderate to high flows. Because these streams are ephemeral, the low flow situation is most common.

2) Seepage from mine spoils

Seepage directly or indirectly from existing mine spoils created since 1925 may be entering the surface water system surrounding the mine area. This could be adding to the salinity of Cow Creek.

Infiltrated surface water and ground water is flushing through the mine spoils causing a buildup of salts. Mine spoil waters range from 1,100 to over 5,000 mg/l TDS, depending on the age and location of the spoils (Appendix B-1).

The spoils are in contact with alluvium (stream-laid deposits), colluvium (slope wash deposits) and undisturbed bedrock. At present the seepage of spoil water into the adjacent material (not considering the seepage created by impoundments) is probably quite low because the mine pit is being dewatered--that is, ground water in the spoils is being drawn toward the pit instead of moving eastward away from the mine. Isolated areas probably exist where porous alluvial or colluvial material lies adjacent to saturated spoils; in those places ground water would probably move away from the mine, eventually surfacing and creating isolated saline areas. Seepage of poor quality spoil water would probably increase when mining is completed and the spoils became resaturated (see section 3, Impacts of the Proposal).

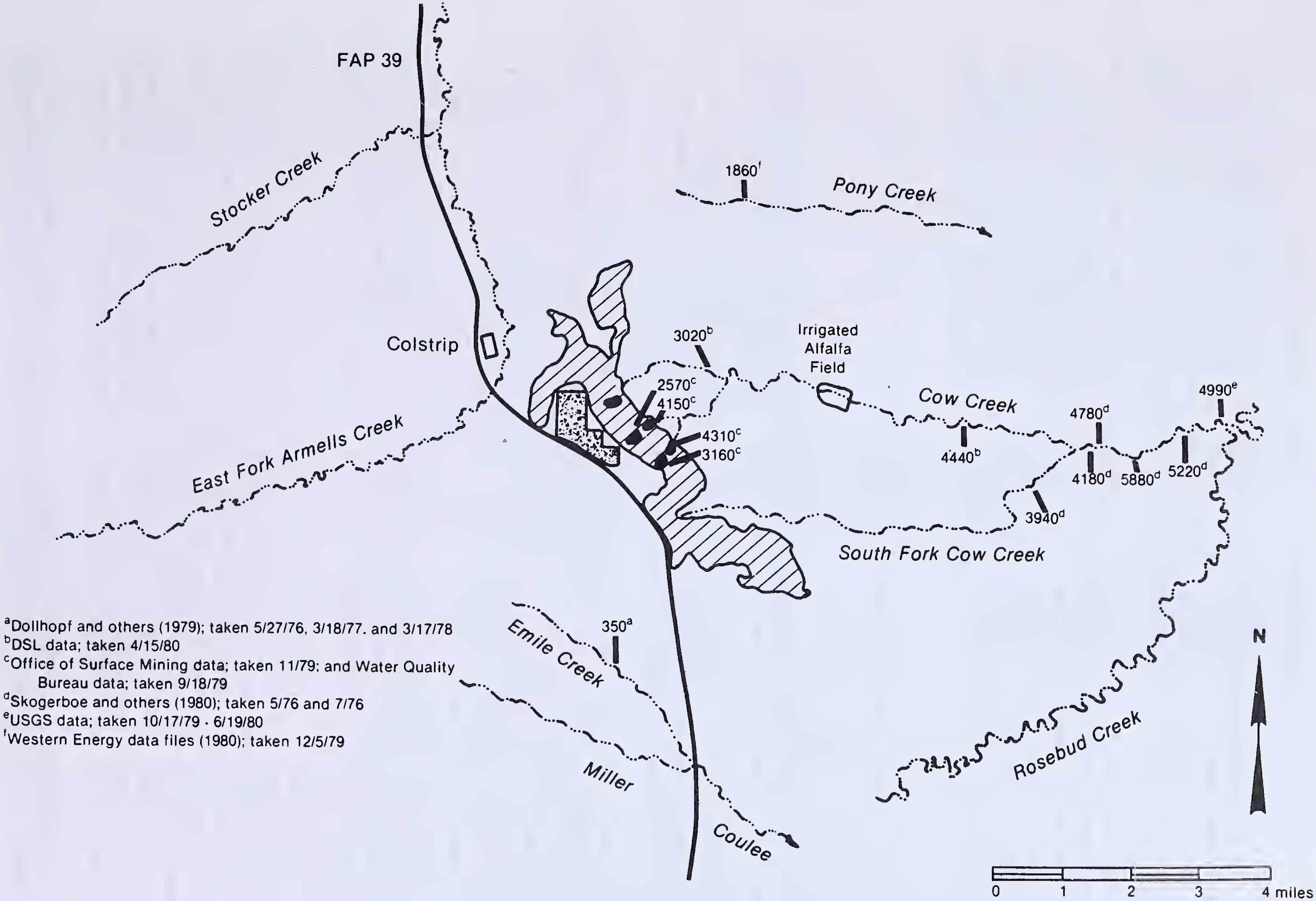
3) Possible effects of seepage on Cow Creek and South Fork Cow Creek

The quality of surface runoff in the headwaters of Cow Creek, in the absence of any mining, would probably be fairly good (TDS less than 2,000 mg/l). This is based on measurements of runoff from Emile (Coalbank) Coulee south of Cow Creek, where TDS was less than 500 mg/l (Dollhopf and others, 1979a) and Pony Creek, where TDS was less than 2,000 mg/l (Western Energy data, 1980). TDS measurements on Cow Creek, however, show higher mineralization--4,000 to over 5,000 mg/l (fig. II-5). Surface waters in Cow Creek appear to be unsuitable for flood irrigation and would possibly harm horses and cattle drinking large amounts (Klarich and Thomas, 1977).

Water that ranges from 600 to 1,800 mg/l TDS has a high salinity hazard if continually used for irrigation (U.S. Department of Agriculture, 1954). The limit of tolerance for alfalfa is 1,300 to 2,600 mg/l, based on studies by Klarich and Thomas (1977). Irrigating alfalfa fields with water as saline as appears to be in Cow Creek could slightly reduce the productivity of the fields.

At well no. S-05 on South Fork Cow Creek, downstream of Area E and Pit 6, TDS in shallow alluvial ground water averaged 5,265 mg/l from 1973-1980 (Appendix B-2). Alluvial ground water in nearby drainages not significantly affected by mining was of substantially better quality than well S-05: an average of 2,209 mg/l TDS in Emile (Coalbank) Coulee 2 miles south of Area E (1975) and 1,860 mg/l in Pony Creek 3 miles north of Area E (1979) (Appendix B-2). This suggests that mining may have degraded the alluvial ground water quality of South Fork Cow Creek.

Possible causes of reduced water quality in the lower reaches of Cow Creek (see fig. II-5) include mining at Area E (saline water is probably seeping from impoundments and mine spoils); the spreader dikes on Cow Creek (which could leach salts from the irrigated soil); and an increased alluvial water table probably caused by increased precipitation in the early 1970s. The relative contribution of mining, irrigation practices, and increased water tables is not known. Further water quality sampling would be needed to better determine the effect of mining on water quality and quantity in Cow Creek and South Fork Cow Creek.



[a] Dollhopf and others (1979); taken 5/27/76, 3/18/77. and 3/17/78
[b] DSL data; taken 4/15/80
[c] Office of Surface Mining data; taken 11/79: and Water Quality Bureau data; taken 9/18/79
[d] Skogerboe and others (1980); taken 5/76 and 7/76
[e] USGS data; taken 10/17/79 - 6/19/80
[f] Western Energy data files (1980); taken 12/5/79

FIGURE II-5.--Selected surface water quality measurements in the Colstrip vicinity.

4) Possible effects of reduced flood flows

The existing impoundments at Area E and the old mine spoils have probably decreased the size of flood flows moving down Cow Creek, South Fork Cow Creek, and to lesser extent East Fork Armells Creek. Floods reaching the spreader dike system on Cow Creek are estimated to be about 30 percent less than if the headwaters of Cow Creek had not been mined. This is based on the ratio of the amount of mined lands above the spreader system to the amount of drainage area that is in its natural state. (Stock watering ponds on some of the tributary ephemerals of Cow Creek may also have the same effect, but were not included in the estimate.) As a result, both the area that can be flood irrigated and the number of times flood irrigation would be possible have been reduced: surface water that could be used for irrigation is being held in the impoundments and the mine spoils.

3. Impacts of the Proposal

a. Water quality

The proposed permit amendment would continue and possibly slightly worsen any hydrologic impacts that may be occurring from past and present mining at Colstrip. Those impacts, which are discussed in section 2 (Description of the Existing Environment) may already be slightly reducing the productivity of irrigated alfalfa fields and unimproved rangeland along Cow Creek and South Fork Cow Creek.

Seepage of saline waters from mining impoundments into the headwaters of Cow Creek would continue the suspected (but as yet undocumented) slight reduction in productivity of irrigated land along the creek for 15-25 years, when the impoundments would be removed. The impact would last 10-20 years if continued mining were not approved; therefore, approval of the proposed mining extension would prolong the effects from the impoundments by about 5 years. The rate of seepage of poor quality water from the impoundments will be reduced because Western Energy will be required to release most of the detained water within 15 days of its reaching the ponds. Some retention will still be allowed, however. DSL could require further measures to reduce seepage (see section 4, Mitigating Measures).

Ground water in existing spoils at the Rosebud mine appears to be of poorer quality than ground water flowing through the Rosebud coal seam (see Appendixes B-1 and B-3). Because ground water would flow toward the active mine pit at Area E, much of the poor quality water in the spoils at Area E would not flow offsite as long as mining continued; however, some of the spoil water would flow outward or downward through adjacent strata and reach the surface. Much of the degraded water would probably reach Cow Creek because the local ground water gradient is to the east.

After mining at Area E has ended, the undisturbed aquifers upgradient from Area E would again be hydrologically connected via the mine spoils with the geologic units downgradient (primarily east) of Area E. Ground water would probably flow through the mine spoils and pick up available salts. The proposed mine extension would approximately double the amount of spoils through which ground water would flow, increasing the amount of salts available for leaching. This could increase concentrations of salts in drainages east of Area E, possibly for centuries.

Seepage from mining impoundments may also be affecting the quality of the McKay aquifer. This is especially likely in the southeast part of Area E, where the interburden is thin and composed of sandstone, possibly allowing water from the spoils to reach the McKay. Because the McKay aquifer in Area E appears to discharge to the surface and near-surface waters of Cow Creek to the east, any degradation would probably add to water quality problems in Cow Creek.

Cumulative impacts on Cow Creek could be great if additional coal in the headwaters of Cow Creek north of Area E is mined (Area D). Such possible future mining, added to the existing and proposed mining in Area E, could disturb most of the headwaters of Cow Creek, adversely affecting surface runoff as described above. Additional mining in Area B west of Area E would probably also degrade the quality of ground water that flows toward Cow Creek.

In addition to mining-related impacts, Montana Power Company plans to place a large settling pond for fly ash from generating units 3 and 4 in the Cow Creek drainage. This pond would ultimately cover 356 acres and would hold 16,500 acre feet of very poor quality water (up to 29,000 mg/l TDS). Montana Power estimates seepage from this pond to be 104 gpm (Sherry Schwend, permit coordinator, written commun., September 9, 1980). This would far exceed the seepage expected from the mine impoundments at Area E and would probably have a considerably worse effect on the quality of water in Cow Creek--and could possibly affect Rosebud Creek into which Cow Creek empties.

Impacts on East Fork Armells Creek from the expansion of Area E would not be significant: the area to be mined is less than 1 percent of the drainage area of East Fork Armells Creek. Cumulative impacts on East Fork Armells Creek from the entire Rosebud mine may be significant: existing mine areas have disrupted approximately 15 percent of the drainage area of East Fork Armells Creek, and could eventually disrupt most of the drainage area of East Fork above Colstrip. Surface water impounded in sedimentation ponds may also adversely affect water quality and runoff timing in East Fork Armells Creek, but the effect from Area E would be small--most of the impact would be from Areas A and B. A small amount of contaminated ground water from mine spoils in Area E could eventually surface within East Fork Armells Creek.

b. Water quantity

The mine extension would require that Western Energy leave existing and proposed sedimentation ponds in place for an additional 5 years or so. Surface runoff from the entire mine would be detained in the impoundments up to 15 days. This would decrease peak flood flows and increase waning flows in Cow Creek, and, to a lesser extent, in East Fork Armells Creek. Some of the runoff would be permanently detained. The 15-day retention of most of the runoff, and the permanent detention of the rest, could possibly affect irrigation practices downstream; however, the effect would be less than at present, because Western Energy would no longer be allowed to permanently detain all runoff.

4. Mitigating Measures

To reduce the temporary seepage of saline water from the impoundments, Western Energy could be required to seal the ponds. This could be done by compacting the surface, applying a chemical sealant such as sodium carbonate (Neff, 1980), or by lining the surface with clay or plastic. The latter method would be the most effective but also the most expensive. Alternatively, Western Energy could be required to drill wells downgradient through which the seepage could be periodically pumped out and returned to the ponds.

To reduce contamination of ground water from saline spoils, Western Energy could be required to selectively replace the saline spoils between the ground water zone and the rooting zone. Selective placement has been demonstrated at nearby Area B although its ability to hydrologically isolate saline materials for the long term has not been evaluated. Selective burial alone would increase the cost of overburden replacement about 10 percent; selective burial and capping with clay would increase costs about 50 percent (Dollhopf and others, 1978c).

The Department could require Western Energy to conduct additional water quality sampling in the Cow Creek drainage. This would help determine to what extent existing mining is degrading surface and ground waters, thereby allowing a better prediction of the effect of the proposed mining extension. The additonal investigations could be required under provisions of the Montana Strip and Underground Mine Reclamation Act (82-4-222 MCA). Samples should be taken above the mine, within the impoundments, directly below the impoundments, and at other points along Cow Creek to verify the mine's contribution. Ground water wells, if drilled downgradient of Area E, would detect any movement of degraded spoils water into the interburden and the Rosebud and McKay aquifers.

C. CLIMATE

1. Summary of Impacts

Continued mining in Area E would have no significant impact on the climate. The fugitive emission sources are all at ground level and the emission rates are not of sufficient magnitude to affect either precipitation or radiation balance. Any climate modification at Colstrip would probably be due to the burning of coal in generating units 1-4 instead of mining activities (U.S. Department of Interior and Montana Department of State Lands, 1980).

2. Description of the Existing Environment

The semiarid climate at Colstrip is indicative of insufficient moisture to sustain dense vegetation growth (Critchfield, 1966) and is typical of the continental steppes of the northern Great Plains. Precipitation is low but variable and falls primarily during the warmer months. Daily temperature variations are large, and seasonal temperature variations are pronounced. Surface humidity is low. The prevailing wind speeds are moderate.

Mean annual precipitation is 15.8 inches, about 50 percent of which occurs from April through June, 20 percent in the winter, and the remainder in the fall. At least 0.01 inches of precipitation falls during 95 days in an average year. Consumptive water use (the total moisture output resulting from soil surface evaporation, plant growth and transpiration) is calculated to be 22.8 inches (Toy and Munson, 1978). Since this exceeds annual precipitation by 7 inches, moisture deficiency affects vegetation development and possibly reclamation success (see Vegetation). Recurrence intervals for 6- and 24-hour precipitation events are presented in table II-4.

Mean annual temperature is about 45°F. Temperatures are lowest in January, with a mean minimum of 8°F., and highest in July, with a mean maximum of 90°F. Relative humidity is highest in winter and lowest in July. The potential growing season, based on the freeze-free period of 115 days, is effectively terminated during midsummer when drought-induced dormancy of vegetation occurs (Toy and Munson, 1978).

Winds from the northwest dominate at Colstrip. Wind from a single 22.5-degree sector persisted for 12 or more hours on only 22 occasions during 1 year of measurement, 50 percent of these occurring during the winter (Super and others, 1973). Average winter wind speed ranges from 14 miles per hour (mph) at a height of 300 feet to 7 mph at ground level. Wind speeds greater than 17 mph occur less than 7 percent of the time. Vertical air movement at Colstrip is characterized by a high frequency of ground-based thermal inversions (Super and others, 1973) and an annual mean maximum mixing depth of 3,414 feet above ground level (Heimbach and Super, 1973).

The regional volume of FES 80-1 (U.S. Department of Interior and Montana Department of State Lands, 1980) and the previous EIS on Area E (Montana Department of State Lands, 1977) contain detailed analyses of the climate at Colstrip. Climatic conditions have important effects on reclamation and revegetation success and on air quality impacts.

3. Impacts of the Proposal--see Summary of Impacts.

TABLE II-4.--Size of largest storm expected at Colstrip during various lengths of time

Length of event	Size of largest storm (inches)						
	Number of years considered						
	2	5	10	25	50	100	200
6 hours[1]	1.00	1.30	1.60	2.00	2.20	2.40	-
24 hours[2]	1.25	1.74	2.04	2.38	2.62	2.83	3.03

[1] Values taken from Miller and others (1973).

[2] Values calculated from precipitation records at Colstrip, 1948-1976.

D. AIR QUALITY

1. Summary of Impacts

Particulate and gaseous emissions from Area E would continue to contribute slightly to the significantly reduced air quality at Colstrip. Increases in ambient particulate and gaseous pollutant concentrations would be primarily caused by construction of Colstrip units 3 and 4, not continued mining in Area E.

2. Description of the Existing Environment

Air quality in the town of Colstrip does not meet the National Ambient Air Quality Standards (NAAQS) because of high concentrations of total suspended particulate (TSP). Because of this, the U.S. Environmental Protection Agency has designated a nonattainment area comprising 120 square miles centering on Colstrip. Western Energy Company petitioned the designation in December, 1979; however, the Montana Air Quality Bureau determined the application was incomplete. Western Energy Company is in the process of responding to the deficiency letter. Monitoring data indicate that elevated TSP concentrations occur only in the town of Colstrip and adjacent to the mining areas, not in the entire nonattainment area. The high TSP concentrations in the town and mining areas result almost entirely from mining and construction, power plant operation, motor vehicle traffic, and wind erosion of exposed areas, primarily from exposed overburden. Wind erosion from cropland and rangeland is minimal (Dennis Loreth, District conservationist, Forsyth, oral commun., May 5, 1980). The Montana Power Company (MPC) #1 high volume air sampler (hi-vol) 1.5 miles north of Colstrip showed a TSP geometric mean concentration of 20.2 ug/m^3 during 1973-1979. This site is upwind of the town and mining operations and is therefore not heavily influenced by activities in those areas. The Burlington Northern (BN) site maintained by the Montana Air Quality Bureau (AQB), 2.5 miles southeast of Colstrip at 200-250 feet above ground level, showed a TSP geometric mean concentration of 21.8 ug/m^3. The McRae site, 14.5 miles southeast of Colstrip, showed TSP geometric mean concentration of 14.5 ug/m^3 for the years 1974-1979. Even though the BN and McRae sites are downwind of the town and mining activities, the TSP concentrations are similar to those measured upwind of the mining activities (table II-5) and similar to the 21.1 ug/m^3 measured in areas of Montana considered to be pristine (U.S. Department of the Interior and Montana Department of State Lands, 1980).

Within a radius of 1.5 miles from Colstrip, an area of about 7 square miles, TSP concentrations are much higher than the background level of 10-20 ug/m^3. Results from monitoring station MPC #3, located in the center of Colstrip, show that the NAAQS for TSP were exceeded repeatedly during 1974-1979. The TSP annual geometric mean exceeded the primary NAAQS (75 ug/m^3) 5 of the 6 years; the 24-hour standard (260 ug/m^3; not to be exceeded more than once per year) was exceeded 4 of the 6 years. The source of this particulate is a combination of coal mining and handling, power plant operation, wind erosion of exposed areas, construction activities, and dust from paved and unpaved roads. Although particulate emissions from these sources can be estimated, the percentage contribution of each to the ambient TSP concentrations is not known.

No adverse human health effects have been reported from exposure to TSP concentrations of 86 ug/m^3 (Montana Department of Health and Environmental Sciences, 1980), which was the TSP geometric mean concentration in Colstrip during 1974-1979. These concentrations do indicate a potential human health problem, especially under long term exposure. Further dust suppression measures would reduce the potential for respiratory disease (see section 4, Mitigating Measures).

Very high TSP concentrations have also been recorded on the area A permit areas downwind of the mine and the coal handling facilities (table II-5; sites WECo 3 and WECo 4). Because these concentrations are measured in areas to which the general public does not have access, the NAAQS do not apply. Workers sporadically have been exposed to levels that exceed the Mine Health and Safety Administration (MSHA) standard of 2000 ug/m^3 for an 8-hour shift. This indicates a potential health problem even though none has been reported: exposure to respirable coal dust in surface mining operations may cause coal worker's pneumoconiosis (CWP) in a small percentage of the workers. Those working in jobs known to produce the highest concentrations of respirable coal dust (cleaning, drilling, welding and tipple work) have a greater chance of developing CWP (Fairman and others, 1977).

Construction of Colstrip units 3 and 4 will be a major but temporary source of particulate and gaseous pollutants. During the estimated construction period of 50 months, particulate and gaseous emissions could average up to 1,500 tons/year and 1,000 tons/year respectively. However, these emissions are not expected to present a significant health hazard (on-file report, Montana Department of State Lands).

TABLE II-5.--Total suspended particulate concentrations at Colstrip

[Location is in relation to Colstrip]

Site Location	MPC 1 1 Mile N			MPC 3 Center Of Town			WECo 3 2.1 Miles SW			WECo 4 1.7 Miles SW			BN 2.5 Miles SE			McRea 14.5 Miles SE		
	AGM[1]	2nd Max.	High	AGM	2nd Max.	High	AGM	2nd Max.	High	AGM	2nd Max.	High	AGM	2nd Max.	High	AGM	2nd Max.	High
1974	21	93	79	115	612	515	---	---	---	---	---	---	13	119	57	12	63	60
1975	19	120	112	86	413	382	---	---	---	---	---	---	19	129	109	9	59	49
1976	28	121	112	103	428	412	---	---	---	---	---	---	28	104	92	17	86	86
1977	18	250	98	79	378	245	106	741	664	44	422	342	25	95	71	17	102	36
1978	15	115	93	59	361	255	92	2150	546	51	1080	480	17[a]	138[a]	112[a]	---	---	---
1979	34	135	119	89	442	339	163	916	810	360	4430	2870	35[b]	174[b]	165[b]	20[b]	69[b]	54[b]

[1] Annual geometric mean.

[a] For period June through August and October through December, 1978.

[b] For period January through September, 1979.

3. Impacts of the Proposal

Fugitive dust emissions from continued mining in Area E would continue at present rates. The emissions would be composed of coal dust, topsoil and overburden particles, and gasoline and diesel fuel combustion particulate (table II-6).

The major sources of coal particulate would be vehicle traffic, primarily crawler-dozer activity around the surge pile and the coal handling facilities, which would account for 44 percent and 35 percent, respectively, of total controlled coal dust emissions. Coal drilling, dumping, and removal (table II-6) would contribute minor amounts of coal dust.

Wind erosion of exposed areas and overburden removal are the major sources of non-coal particulate (listed as "other" in table II-6). Due to the high silt content of the overburden (40 percent), overburden particles are easily suspended by wind and dragline activity. These activities are responsible for 66 percent of the controlled non-coal emissions. Topsoil and subsoil removal and replacement and haul road traffic account for 31 percent of the 845 tons emitted annually. Other than reducing the fall distance during overburden removal, there is little that could be done to further reduce these emissions.

Only during the warmer months when the winds are from the southeast would residents of Colstrip be exposed to dust originating from Area E. At present it is not possible to predict to what extent dust from Area E contributes to the TSP concentrations measured in the center of town. The contribution is probably much less than that from construction activities and other coal handling facilities.

Particulate and gaseous emissions from gasoline and diesel fuel combustion (tables II-6 and II-7) are not major and would not affect the air quality at Colstrip.

Particulate and gaseous emissions would end with the cessation of mining at Area E. If reclamation were not successful, as might happen in a prolonged drought, topsoil loss due to wind erosion could continue at rates of 5 tons/acre/year (Bohn and Cowherd, 1977, assuming a silt content of 16.5 percent in surface salvage material) indefinitely--a total of 2,250 tons of particulate emissions per year from the 450-acre permit area.

4. Mitigating Measures

Coal dust emissions could be substantially reduced by watering the coal storage pile and using a baghouse in conjunction with the coal handling facilities (table II-6). Watering the storage pile would reduce coal particulate emissions from the pile by 50 percent to an average of 87 tons/year. Installing a baghouse plus fully covering all conveyors and transfer points would eliminate coal dust emissions from those sources.

TABLE II-6.--Estimated potential and controlled particulate emissions from Area E

Activity	Extent of activity per year	Emission factor	Uncontrolled emissions (tons/year) Coal	Uncontrolled emissions (tons/year) Other particulate	Ref.	Control proposed by Western Energy	% control	Controlled emissions Coal	Controlled emissions Other	BACT control strategy	% control	with BACT (coal)
Topsoil and subsoil												
removal------------	407,100	0.38 lbs/yd^3		77	1	---	---		77	---	---	
replacement--------	407,100	0.38 lbs/yd^3		77					77			
						Revegetation within				Revegetation		
Exposed areas--------	103.2 acres	12.2 tons/acre		1255	4	one growing season	75		314	within one	75	
										growing season		
Overburden drilling--	2,227 holes	1.5 lb/hole		1.7	1	---	---		1.7	Bag collector	90	
										on air drill		
Overburden blasting--	64 blasts	14.2-85.3 lb/blast		0.4-2.7	1	---	---		0.4-2.7	---	---	
Overburden removal---	16.4 x 10^6 yd^3	0.0056-0.053 lb/yd^3		46-435	1	---	---		46-435	---	---	
Coal drilling--------	7,238 holes	0.22 lb/hole	0.8		1	---	---	0.7	---	Bag collector	90	0.1
										on air drill		
Coal blasting--------	302 blasts	25.1-78.1 lb/blast	3.8-12		1	---	---	3.8-12	---	---	---	3.8-12
Coal removal---------	3.1 x 10^6 tons	0.0035-0.014 lb/ton	5.4-22		1	---	---	5.4-22	---	---	---	5.4-22
Haul road traffic----	171,880 vmt	8.48 lb/vmt		728	1	Treatment with $CaCl_2$	85		109	Treatment with	85	
										$CaCl_2$		
Coal dumping---------	3.1 x 10^6 tons	0.007-0.027 lb/ton	11-42		1	---	---	11-42	---	Negative pres-		
										sure system	85	1.6-6.3
Coal screening-------	3.1 x 10^6 tons	0.1 lb/ton	155		1	Enclosed	50	78	---	Baghouse	99	1.6
Coal crushing												
primary------------	3.1 x 10^6 tons	0.02 lb/ton	31		1	Enclosed	50	14	---	Baghouse	99	0.3
secondary----------	936,000 tons	0.06 lb/ton	28		1	Enclosed	50	16	---	Baghouse	99	0.3
Conveyors and												
transfer points----	3.1 x 10^6 tons	0.2 lb/ton	310		1	Partially covered	90	31	---	Fully covered	100	0
Train loading--------	600,000 tons	0.0002 lb/ton	0.1		1	---	---	0.3	---	Retractable		
vehicle traffic around										chute	95	0
storage pile-------	continuous	0.02-0.26 lb/ton	25-325		6	---	---	25-325	---	Water	50	12.5-162
Surge pile-----------	1.6 surface acres	u = 3.3 m/sec	37		1							
		1.6u lb/hr				---	---	31	---	Enclosed	99	0.3
Coal stacker---------	2.5 x 10^6 tons	0.0003-0.0011 lb/ton	0.4-1.4		6	Partially enclosed		?		Enclosed	99	0
Diesel fuel----------	675,000 gallons	23.7 lb/10^3 gal		8.0	2		---		---			
Gasoline-------------	48,000 gallons	12 lb/10^3 gal		0.3	2	---	---		8.0	---	---	
Unit trains----------	60					---	---		0.3	---	---	
distance traveled--	240 roundtrip	0.8 lb/mile		5.8	3							
	Colstrip-Billings					---	---		5.8	---	---	
Coal transported---	600,000 tons	Unknown	Unknown			---	---	---	---	---	---	---
Mine-associated												
population---------	180	0.06 tons/person/yr.		10.8	5	---	---		10.8			
		Total	608-964 (avg.) 786	2,210-2,601 (avg.)2,406				222-578 (avg.)400	650-1,041 (avg.)845			26.1-205 (avg.) 116
		Percent control						49.1	64.9			85.2

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[1] U.S. Environmental Protection Agency (1979).

[2] U.S. Environmental Protection Agency (1976).

[3] Hugh Williams, Burlington Northern Inc., written commun., May 23, 1980.

[4] Bohn and Cowherd (1977).

[5] U.S. Environmental Protection Agency (1973).

[6] Bohn, Cuscino, and Cowherd (1978).

TABLE II-7.--Gaseous emissions (tons/year) from mining at Area E

Activity	Annual extent	NO_x	SO_x	HC	CO	Alde- hydes	Organic Acids	HCN	Ref.
Blasting (ANFO)[a]-----	2,200 tons	3.52	-	-	46.9	-	-	0.1	1
Unit trains---	14,400 miles	118.0	13.0	4.3	15.8	1.3	1.6	-	2
Diesel fuel---	675,000 gallons	141.0	10.5	14.2	33.2	3.3	-	-	3
Gasoline[b]-----	48,000 gallons	8.1	0.2	8.6	109.0	-	-	-	3
Mine-associated population--	180 persons	30.6	12.6	23.4	61.2				4
Total----------------------------		301.0	36.3	50.5	266	4.6	1.6	0.1	

[1] Chaiken and others (1974).
[2] Hugh Williams, Burlington Northern Inc., (written commun.) May 23, 1980.
[4] U.S. Environmental Protection Agency (1973).
[a] Ammonium-nitrate fuel-oil mixture.
[b] Assumes 12 miles/gallon.

In total, if all the Best Available Control Technology (BACT) measures were implemented, coal dust emissions would be reduced from 400 tons per year to 116 tons per year, a 71 percent reduction (see table II-6). This would reduce potential health hazards to mine workers but would only slightly reduce ambient particulate concentrations at Colstrip.

Western Energy Company is presently using the BACT for the reduction of fugitive noncoal dust emissions (table II-6; U.S. Environmental Protection Agency, 1979). Minimization of the fall distance from the dragline during overburden replacement could reduce dust somewhat.

E. SOILS

1. Summary of Impacts

Impacts on soils would not be significant because the proposed soil salvage plan and complex slope system would prevent excessive loss of soil during and after mining. Revegetation success could be further enhanced by additional soil sampling prior to stripping in order to salvage only the most suitable soil material.

2. Description of the Existing Environment

Most of the soils in the proposed permit area are moderately well developed with small areas of well developed and poorly developed soils (table II-8). The soils in the permit area formed from materials ranging from alluvium to sandstone, siltstone, and shale.

Capability groupings (U.S. Department of Agriculture-Soil Conservation Service, unpublished soil survey, Rosebud County Area) indicate that approximately 364 acres (81 percent of total permit area) are suitable for cultivation with severe (Group III) or very severe (Group IV) limitations. Approximately 29 acres (6 percent of total permit area) are suitable for use as rangeland (Groups VI and VII). The remaining 57 acres (13 percent of total permit area) are occupied by rock outcrops and minor soil inclusions. None of the soils in the permit area meet the criteria for prime farmland. Erosion is a major factor limiting land use. This limitation is a result of dissected topography, large areas with sandy textures, and periodic drought.

3. Impacts of the Proposal

Some impacts on the soils of the proposed permit area are unavoidable. These impacts include loss of the natural soil profile, soil structure, organic matter, pore space, and pore continuity. Because of these impacts, this area would probably be more sensitive to mismanagement and drought than before disturbance, for perhaps several decades after mining. Long term impacts (more than several decades after mining) are uncertain since there is not enough information to determine all the conditions and practices required for long term success. Complete revegetation failure is unlikely (see Vegetation).

TABLE II-8.--Soil resources in proposed disturbance area of section 2 of Area E

Soil Series	Subgroup	Acres	Approximate Soil Salvage Volume (acre-feet) Proposed	Approximate Soil Salvage Volume (acre-feet) Potential	Primary Limiting Factor	Average Surface Texture (0-6")* %Sand/%Clay	Average Subsurface Texture (>6")* %Sand/%Clay
Busby	Borollic Camborthids	196.1	532.3	532.3[c]	Texture	72/9 (SL)	68/10 (SL)
Chinook	Aridic Haploborolls	58.9	147.3	147.3[c]	Texture	71/12 (SL)	63/13 (SL)
Kremlin	Aridic Haploborolls	25.9	103.6	77.7[c]	Excess Salts	38/25 (L)	31/29 (CL)
Yamac	Borollic Camborthids	79.2	396.1	198.0[c]	Excess Salts	43/31 (CL)	24/35 (CL)
Cabbart	Ustic Torriorthents	17.3	34.7	25.9	Bedrock	29/33 (CL)	21/31 (CL)
Vanstel	Borollic Haplargids	3.7	7.4	9.3[c]	Excess Salts	31/27 (L/CL)[b]	13/40 (SiCL/SiC)[b]
Yawdim	Ustic Torriorthents	11.5	23.1	11.5[c]	Bedrock/ Clay	44/31 (CL)	14/39 (SiCL)
	Totals	392.6[a]	1,244.5	1,002.0			

[a] The remaining 57.4 acres of total 450 acres to be disturbed are composed of soil mapping unit inclusions and rock outcrops.

[b] Borderline textures.

[c] Soil profiles for these series are variable. Potential salvage volumes are subject to change following additional sampling.

*U.S. Department of Agriculture textural classes:

C = Clay
CL = Clay Loam
L = Loam
LS = Loamy Sand
SL = Sandy Loam
SCL = Sandy Clay Loam
SiCL = Silty Clay Loam
SiL = Silt Loam
SiC = Silty Clay

Western Energy's proposed reclamation plan would salvage a sufficient volume of soil material and prevent excessive erosion. Because of this, the potential for successful revegetation would be increased.

To prevent the destruction and loss of soil material in the permit area, Western Energy proposes to salvage 1,244.5 acre-feet of soil material from 392.6 acres (table II-8). An unknown additional amount of soil material would be salvaged from associated soil inclusions in the remainder of the 450-acre permit area. This would provide an average minimum cover depth of about 33 inches for the permit area, which is greater than that necessary for adequate biomass production. Recent studies by the Colorado School of Mines Research Institute (1980) demonstrate that perennial grass production consistently increases as salvaged soil depth increases from 0 to 70 cm (28 inches). In addition to the increase in biomass, the water infiltration rate and the rooting depth also increase with an increase in soil thickness.

Proposed and potential approximate soil salvage volumes are presented in table II-8. Duplicate samples of Busby and Chinook soils taken at similar depths show variable texture: one sample for each series is excessively sandy and one sample is not. Samples of Yamac and Vanstel soils at similar depths show similar variability in electrical conductivity (EC--a measure of salt content), with one sample for each series excessively saline and one sample not. Because of this variability among duplicate soil samples, it is not possible to determine whether Western Energy's proposed salvage depths are appropriate. The company has agreed to take additional samples of the Busby, Vanstel, and Chinook series before stripping and analyze them on-site to determine appropriate salvage depths. DSL will require this procedure for the Kremlin and Yamac series.

For the Cabbart and Yawdim soils, salvage would be limited by bedrock at an average of 18 inches and 12 inches, respectively. Western Energy proposes to salvage those soils to greater depths than practical (see table II-8). DSL could require the company to salvage the Cabbart and Yawdim soils only to bedrock (see Mitigating Measures).

Based on the limited soil samples available, it appears that there would be sufficient soil to allow adequate vegetative growth without salvaging excessively sandy and saline materials. At worst, if the more limiting value of the duplicate samples were verified by additional sampling, roughly 500 acre-feet of soil would be salvageable. This would cover the regraded spoils to a depth of about 15 inches, which would be sufficient to allow adequate vegetation growth, because the overburden in this area is not expected to present much of a problem (see Geology). The required additional sampling would probably delineate much more than 500 acre-feet of salvageable soil, however.

By stripping ahead of the active pit in the summer and fall and immediately redistributing the soil material on the regraded spoils, Western Energy will refrain from stockpiling soil material. This will prevent the increase in bulk density (decrease in porosity), decrease in water holding capacity, reduction in the amount of organic matter, and decrease in soil microorganisms found in stockpiled soils (Miller and Cameron, 1976).

Approximately 65 percent of the soils in the permit area contain sand slightly in excess of 70 percent. Fine and very fine sand, which is dominant in these soils, is easily entrained by running water. A small amount of runoff occuring as the result of high intensity storms can cause severe erosion (Schafer and others, 1979). Rapid establishment of vegetation is extremely important in this area. To minimize erosion Western Energy will reconstruct slopes to a complex configuration, seed immediately after the soil material is redistributed (see Vegetation), and apply mulch.

Regraded slopes will range from 5 to 20 percent, averaging 10 percent (see fig. II-3). A 20 percent slope roughly 600 feet long in the northwest part of the permit area would be most subject to erosion. If left bare, erosion rates on this slope could exceed 32 tons/acre/year until the vegetation begins to grow, based on the Universal Soil Loss Equation (U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1977). This would be unacceptably high. To minimize this erosion loss, the company will apply straw mulch at a rate of 1.5-2.0 tons/acre. This will reduce the erosion loss to approximately 3.2 tons/acre/year, a decrease of 90 percent, based on the same equation. This loss is just slightly higher than the "permissable" temporary soil loss of 3 tons/acre/year established for this depth of soil material (U.S. Department of Agriculture, Soil Conservation Service, 1973). To further minimize erosion problems, Western Energy is proposing a complex slope design. For the most part, this design is basically concave, with a small convex area near the top. Such a design has been shown to be least affected by erosion, yield the least amount of sediment, and change shape slower than other designs (Schafer and others, 1979).

4. Mitigating Measures

Western Energy currently plans to salvage the Cabbart and Yawdim soils to a depth greater than the average soil thickness. This would result in taking siltstone and shale bedrock material, which is not suitable for plant growth. DSL could require the company to salvage those series only to bedrock.

F. VEGETATION

1. Summary of Impacts

Impacts on vegetation would not be significant because Western Energy would make maximum feasible use of the reclaimed soil's potential to support diverse native vegetation. Unavoidable disturbance of the soil would probably cause a slight reduction in potential productivity, but this would not limit normal use of the reclaimed minesite for domestic livestock production and wildlife habitat.

2. Description of the Existing Environment

The vegetation of the proposed permit area consists of a variety of native range plant communities as well as some disturbed areas (table II-9). The native plant communities are typical of the rangeland of eastern Montana. A vegetation map, which includes the proposed permit area, can be found in the previous EIS on Area E (Montana Department of State Lands, 1977).

The area to be mined has clusters of ponderosa pine (Pinus ponderosa) and associated shrubs on the ridge tops, various native shrubs, forbs, and grasses occupying the draws and lowland drainage areas, and native range grasses (with scattered shrubs and forbs) on both upper and lower slopes. Western Energy consultants have mapped 12 vegetative community types on the proposed permit area (Ecological Consulting Service, 1975b). These vegetative communities include 2 disturbed grassland types. One of the disturbance types is composed mainly of cheatgrass (Bromus tectorum), which was reported to be the result of overgrazing (Ecological Consulting Service, 1975b). The other disturbance type (designated as "disturbed grassland" in table II-9) is the result of direct disturbance by man in the past by plowing. Complete vegetative community descriptions and productivity data for the vegetative community types listed in table II-9, as well as a comprehensive plant species list for the entire Colstrip area, can be found in the previous EIS on Area E (Montana Department of State Lands, 1977).

The range conditions for the native vegetative community types are given in table II-9 (Ecological Consulting Service, 1975b). Overall, the range condition of the proposed permit area is fair (productivity level 26 to 50 percent of climax vegetation). At present, the total stocking rate for the entire 450-acre permit area is 115 cow/calf units for a 1-month grazing period, or approximately 11.5 cow/calf units for a 10-month grazing period. The potential stocking rate for the entire permit area is 189 cow/calf units for a 1-month grazing period, or 18.9 cow/calf units for a 10-month grazing period (U.S. Department of Agriculture-Soil Conservation Service, 1978).

3. Impacts of the Proposal

Western Energy's proposed revegetation plan, in combination with proper postmining slope design (see Geology) and soil handling procedures (see Soils), would maximize the potential for vegetative reclamation at Area E. Although reclamation success is not guaranteed, the revegetation plan would have a good chance of establishing a diverse native vegetation cover composed of plant species desirable for domestic livestock and wildlife.

All vegetation would be removed from active mining areas. After regrading and topsoiling, the mined area would be reseeded and mulched. The proposed seeding mixture is shown in Appendix F-1. For several decades after mining, reclaimed land would probably not sustain as high

TABLE II-9.--Vegetative communities, acres, range sites, condition, and stocking rates at Area E

[Source: Ecological Consulting Service, 1975]

Code No.	Vegetative Community	Acres	Range Site[1]	Range Condition	Recommended Stocking Rate[3]	Potential Stocking Rate[5]
111.2	Agropyron smithii-Koelaria cristata-Carex filifolia	32.9	Silty	Fair (47)[2]	.30 (9.9)[4]	.53 (17.4)[4]
111.3	Stipa comata-Carex filifolia-Koelaria cristata	46.5	Silty	Fair (32)	.30 (14.0)	.53 (24.6)
111.4	Calamovilfa longifolia-Andropogon spp.	19.2	Sandy	Good (70)	.45 (8.6)	.53 (10.2)
111.5	Bromus tectorum	5.8	---	---	---	---
211	Artemesia tridentata-Koelaria cristata-Agropyron spicatum	62.8	Clayey	Fair (31)	.30 (18.8)	.53 (33.3)
212.1	Artemesia cana-Agropyron smithii-Stipa viridula-Poa spp.	10.2	Overflow	Good (55)	.60 (6.1)	.61 (6.2)
212.2	Artemesia cana-Agropyron smithii-Stipa smithii	117.8	Silty	Fair (41)	.30 (35.3)	.53 (62.4)
213	Rhus trilobata-Stipa comata-Agropyron smithii	39.7	Sandy	Fair (37)	.30 (11.9)	.53 (21.0)
214	Chrysothamnus nauseosus-Agropyron spicatum-Oryzopsis hymenoides	13.4	Dense Clay	Poor (16)	.10 (1.3)	.35 (4.7)
351	Pinus ponderosa-Agropyron spicatum	16.5	Thin-hilly	Excellent (76)	.50 (8.3)	.50 (8.3)
352	Pinus ponderosa-Juniperus scopulorum Agropyron spicatum	2.0	Thin-hilly	Fair (49)	.25 (0.5)	.50 (1.0)
651	Disturbed grassland	79.6	---	---	---	---
653	Corral sites	1.5	---	---	---	---
S	Sandstone outcrops	2.1	---	---	---	---

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[1] Follows U.S. Soil Conservation Service (SCS) criteria.

[2] Percent of climax vegetation--poor: 0-24; fair: 25-49; good: 50-74; excellent: 75-100.

[3] For existing range condition; units are AUM's/acre (animal unit months/acre).

[4] Number in parentheses is total AUM's (AUM's/acre multiplied by the acres in each vegetative community).

[5] Based on an average of 100% and 75% potentials for each range site (from SCS Montana Grazing Guides).

a grazing pressure as what could have been achieved before mining under optimum management. That potential ranges from .35 to .61 AUM/acre, depending on community type, for a weighted average of .42 AUM/acre. This slight reduction in optimum grazing potential would occur because of the unavoidable impacts on soils (see Soils). The condition of the reclaimed land would, however, be better than its current (fair) condition. This is based on grazing trials at Area A, where the postmining stocking rate is roughly double the premining rate (Earl Murray, Western Energy Company, oral commun., January 21, 1981).

Vegetation on reclaimed land would probably be more sensitive to mismanagement and drought than on undisturbed land, again owing to unavoidable impacts on soils.

Western Energy has met with limited success in reestablishing trees, shrubs, and forbs in reclamation areas at the Rosebud mine, owing to competition for moisture from native grasses. Further problems have resulted from the destruction of reestablished native grasses by the machinery (tree spade, etc.) needed to plant shrubs and trees. To avoid problems of this type, Western Energy proposes to plant a temporary stabilizer crop of wintergraze to prevent excessive erosion in areas where shrubs, trees, and forbs are desired. After the wintergraze is established trees, shrubs, and forbs will be planted. Planting of native grasses in these areas will be delayed for one or two growing seasons to allow the trees, shrubs, and forbs to become established. Using this procedure Western Energy would likely be able to establish a diverse vegetative cover. Wintergraze is an annual species and will not compete as well as native grasses for moisture. The wintergraze will not be part of the permanent vegetation; therefore, long term impacts as a result of the destruction from planting machinery will be minimal.

After the native vegetation has become established, Western Energy (with DSL approval) will incorporate a planned grazing system to compensate for the grazing preferences of livestock. Planned grazing systems reduce overuse by livestock of preferred plant species and the underuse or nonuse of other species in the vegetative community.

Native vegetation in the Colstrip area contains adequate nutrients for plant growth (Munshower and DePuit, 1976).

Phosphorus levels in the native grasses of this area are usually below requirement levels for all classes of range cattle--the common practice of feeding phosphorus supplements in this area is well founded (Munshower and others, 1977).

Molybdenum (Mo) has been known to accumulate in legumes in the Colstrip area (Erdman, 1978). This could create copper (Cu) deficiency symptoms in livestock because of a Cu:Mo imbalance. The revegetation seed mixtures do not contain a significant amount of legumes, therefore, copper deficiency problems are not expected (see Geology, section 3b, Overburden).

G. WILDLIFE

1. Summary of Impacts

Continued mining at Area E would not have significant long term impacts on wildlife because Western Energy would reestablish wildlife habitats similar to those that existed before mining.

2. Description of the Existing Environment

The proposed permit area is essentially an island of undisturbed native vegetation surrounded by operating mine machinery on three sides and highway FAP 39 to the south. The mine machinery includes draglines, scrapers, front-end loaders, and trucks traveling along adjacent access roads. Highway FAP 39 has right-of-way fencing on both sides. Because of these disturbances, the permit area presently contains no major use for wildlife. Use is restricted to a few small mammal species, songbirds, and possibly occasional game birds.

Wildlife observations and census data presented in this statement were collected by Western Energy consultants for various study areas that included Area E (Ecological Consulting Service, 1973, 1975a, 1976, 1977, 1978, 1979). By use of these wildlife inventory data and corresponding vegetative habitat types, a prediction can be made as to what species of wildife common to the Colstrip vicinity would use the permit area if there were no surrounding disturbances. This is done by comparing vegetative habitat types that presently exist in the permit area with those of adjacent areas. For example, Ecological Consulting Service sighted mule deer mostly in the sage-grassland, skunkbush sumac-grassland, and ponderosa pine-grassland habitat types; therefore, mule deer would probably be periodically found on similar habitat types in the permit area if the adjacent disturbances did not exist. Table II-10 lists wildlife species and the percentage of the 450-acre permit area that is their most common habitat. This serves as a basis for comparison with postmining habitat types (see following impacts section). The previous EIS on Area E (Montana Department of State Lands, 1977) discusses in greater detail the habitat preferences of species found on and near the permit area.

3. Impacts of the Proposal

The remaining undisturbed wildlife habitat at Area E would be mined out by about 1985. This habitat, however, is little used by wildlife owing to the surrounding mining-related disturbance. For this reason the habitat lost during mining would affect only species that are common in the Colstrip area, such as small mammals, songbirds, and possibly a few game birds.

Impacts on wildlife following reclamation would be insignificant because Western Energy proposes to reestablish habitat types similar in vegetative communities and area to the present native communities (see Vegetation). For example, approximately 55 percent of the present area supports vegetative communities commonly used by mule deer. Assuming successful revegetation, which appears likely (see Soils and Vegetation), approximately 65 percent of the postmining area would have vegetative communities that are commonly used by mule deer (table II-10). For other game and nongame wildlife species, the revegetated plant communities would be roughly equal or greater in area than the original plant communities (table II-10). An increase in habitat area for one wildlife species does not indicate a decrease for another species, because the proposed permit area contains 85 disturbed acres that would be used for establishment of vegetative communities useful to various wildlife species. Therefore, an increase in animal habitat area is feasible.

In the Colstrip area, raptors normally nest in cavities of ponderosa pine snags or sandstone outcrops and bluffs (Ecological Consulting Service, 1979). No active raptor nests are known in the area to be mined. Western Energy proposes to replace the small areas of ponderosa pine now found on Area E, which would eventually provide nesting sites for raptors as the trees grew to maturity. In addition, Western Energy will attempt to simulate the sandstone outcrops and rocky knobs presently in the area. During or immediately following soil salvage around the outcrops, front-end loaders or trucks will be used to remove the exposed sandstone to a size limited by equipment capabilities. The sandstone will be relocated on regraded knobs or ridgetops prior to topsoil redistribution. Although these outcrops are probably not large enough for raptor nests, the outcrops will provide a good microhabitat for small mammals and reptiles which are prey for raptors.

No threatened or endangered species are known to use the permit area, so none would be adversely affected by approval of the permit. Area E may have been habitat for the golden eagle before mining began (see table II-10), but the company will attempt to reestablish ponderosa pine, which when mature are potential habitat for golden eagles.

H. SOCIOLOGY

1. Summary of Impacts

Continued mining in Area E would contribute a small amount to the continuation of existing social impacts in the Colstrip-Forsyth area.

The Final EIS written on Areas A and E in 1977 (Montana Department of State Lands, 1977) stated that the expansion of the Area A and E portions of the Rosebud mine would not measurably affect the social structure of the Colstrip-Forsyth area. Similarly, continuation of mining in Area E would not result in additional impacts to the area's social structure, because the 58 mine employees and their families are already residents of the Colstrip-Forsyth vicinity. Area E would not cause further population growth in Rosebud County. Area E would not add a significant amount to air pollution or noise in Colstrip and thus would not contribute significantly to the social and health problems attendant to those impacts (see Air Quality).

TABLE II-10.--Comparison of existing and postmining vegetative habitat types associated with various wildlife species

Species	Existing Habitat[1] (acres)	Postmining Habitat[1] (acres)	Percent Total Area[2] (existing)	Percent Total Area[2] (postmining)
Mule Deer (*Odocoileus hemionus*)	249	288	55	65
Pronghorn Antelope (*Antilocarpa americana*)	289	366	65	80
Sharp-tailed Grouse (*Pediocetes phasianellus*)	329	404	75	90
Sage Grouse (*Centrocercus urophasianus*)	191	225	40	50
Hungarian Partridge (*Perdix perdix*)	348	433	75	95
Merriam's Turkey (*Meleagris gallopava merriami*)	19	29	5	5
Raptors[3]	21	33	5	5

[1] Existing and postmining habitat types associated with each species are shown in appendix G-1.

[2] Rounded to nearest 5 percent. Total exceeds 100 percent because of overlap in habitat use.

[3] Raptors commonly observed in the Colstrip area:

Harrier (*Circus cyaneus*)
Red-tailed hawk (*Buteo jamaicensis*)
Rough-legged hawk (*Buteo lagopus*)
Golden eagle (*Aquila chrysaetos*)
Prairie falcon (*Falco mexicanus*)

2. Description of the Existing Environment

a. Population

The Colstrip-Forsyth area has experienced relatively rapid population growth over the past decade due to increased mining and construction of generating units 1-4 at Colstrip. This population influx reversed a trend of population decline dating to the 1930's (fig. II-6).

Colstrip and Forsyth received over 80 percent of Rosebud County's new settlement from 1970 to 1976. Colstrip's population grew from 200 to 2,682, more than a ten-fold increase, while Forsyth grew from 1,873 to 2,661, a 42 percent increase. Rosebud County's population peaked at nearly 11,000 in 1973, the height of construction employment for generating units 1 and 2 (Meadowlark, 1978). Growth had stabilized by 1977, when the Final EIS on mining areas A and E was written. In 1980 the population began to increase again as workers arrive to construct Colstrip generating units 3 and 4.

About 180 people live in the Colstrip-Forsyth area as a result of the Area E mine. This represents 2 percent of the estimated 1979 population of Rosebud County. Of the 180, 58 are miners at Area E and the remainder are associated ancillary workers and the families of both groups.

b. Social structure

The social structure of the Forsyth-Colstrip area in 1970 was dominated by ranchers, farmers, Indians, and small town populace. The attitudes of many people in the area was shaped by a land ethic and esthetic values. The use of the land was fundamental to the culture and way of life of persons who lived in the Northern Great Plains, including many American Indians, whose religion and philosophy saw man as part of the natural environment and believed much of man's identity derived from interaction with the natural world.

Agriculture has long been the principal economic force in the area; the region's culture is firmly rooted in the American agricultural ideology. The persons who lived in the area were used to little congestion, a well-established sense of community, and a slow pace of life. In the 1970's construction workers, miners, ancillary workers, and their families were added to this social structure. The resulting alteration in the way of life and interaction systems of the predominately agricultural society constitute the greatest impacts to date on the local social environment.

The population growth from coal development in Rosebud County changed the way individuals related to one another. People become less oriented toward others and more oriented towards institutions--for example, people came to depend on law enforcement officals to control crime instead of the traditional informal help between residents. The process included a

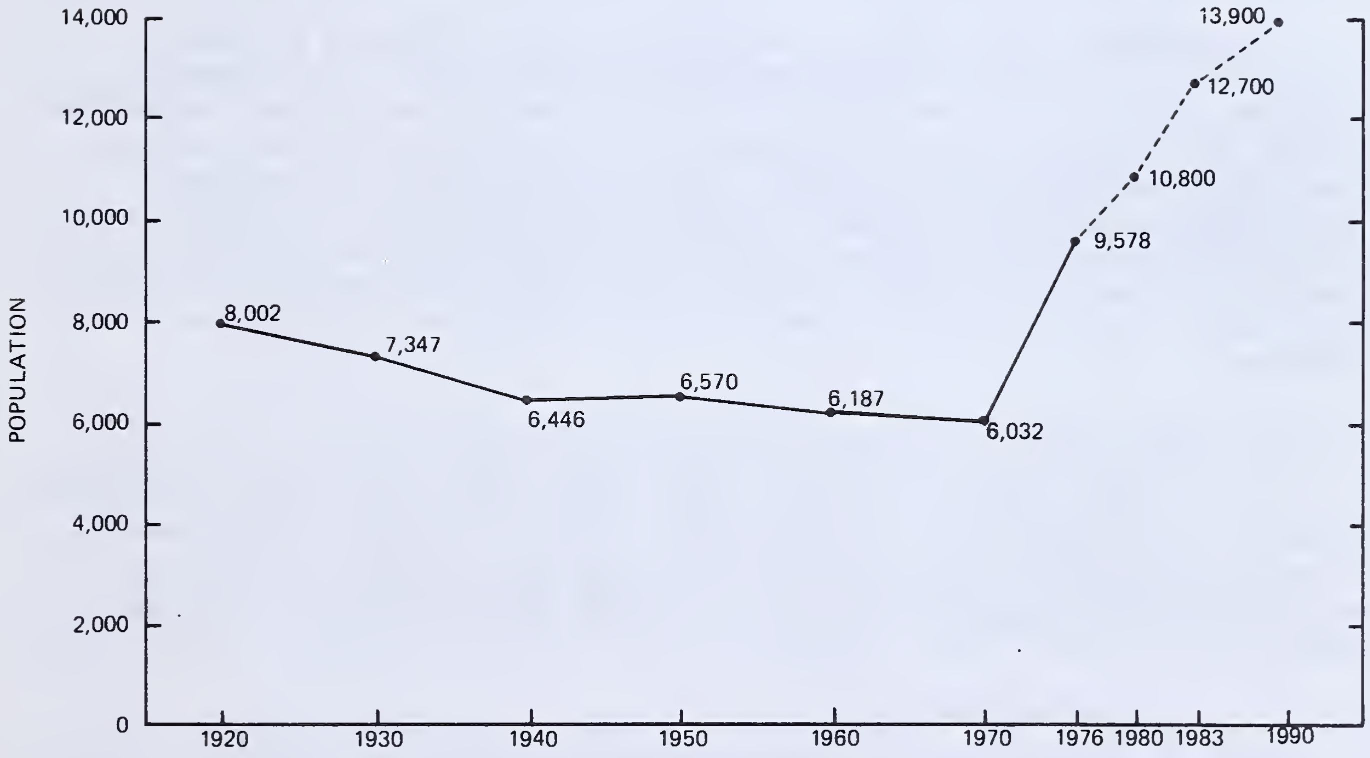

FIGURE II-6.--Rosebud County population. Dashed line indicates projected population growth.

decline in local autonomy, exposure to different norms, and a fragmenting of the existing social order based on agriculture and building of a new one based more on urban-industrial values. Indicators of this change included less personal business transactions, greater emphasis on motorized recreation, and increasing rural subdivision.

c. Attitudes toward coal development

The differences of opinion between Colstrip-Forsyth residents and area ranchers concerning local coal development discussed in the previous EIS on Area E (Montana Department of State Lands, 1977) still exist. A study by Meadowlark (1978) found that the majority of Colstrip and Forsyth residents supported additional coal development; about one-third said the existing level of coal development was "about right". In contrast, the majority of ranchers interviewed felt that the existing amount of coal development was about right; nearly one-third stated it was too high.

The problems identified by the ranchers as being their greatest concerns are to some extent attributable to coal mining. For example, problems with litter, road maintenance, trespassing, power plant emissions, noise, and friction between neighbors--all mentioned as problems by the ranchers interviewed--have probably been exacerbated by coal-related population increases. The results of the attitude study are consistent with those reported in Gold and others (1974), which shows the value conflicts between the rural, agrarian lifestyle of the ranchers and the more urban, industrialized lifestyle of the mining and construction workers.

d. Noise

Noise from mining in Area E is far enough from Colstrip and isolated further in the mine pit to be negligible in Colstrip. Only occasional blasting is noticeable in town; because it is intermittent, it occurs only during daytime work hours, and its short duration makes annoyance unlikely (FES 79-29--U.S. Department of the Interior, 1979).

e. Mental health

Many residents of Colstrip feel a general malaise or uneasiness, apparently due to feeling bored or trapped in a place that they feel is not a suitable home (Eric Deeter, Director, Rural Health Initiative, oral commun., July 30, 1980). The U.S. Department of Housing and Urban Development (1976) identified other possible causes of this problem as a speeded pace of life, congestion and overcrowding, inflation in prices, fear of change for present residents, and lack of activities and belonging for newcomer families. Some Colstrip residents have cited the lack of family-oriented recreation (for example, bowling) as a cause of boredom (Keith Bennett, Bureau of Land Management, oral commun., July 31, 1980). This lack of opportunities for social activities could lead to problems in some individuals such as drug abuse, overeating, and excessive drinking.

Colstrip has a serious drug problem. Alcoholism among teenagers is bad because they come in contact with newcomers continually, have few employment opportunities, and too few recreational opportunities. Many young people have the access to and the money to buy alcohol and drugs. The proportion of young people in Colstrip is also high.

Colstrip residents face stressful situations such as changes in population size, changes in social status, and lack of permanance, all of which can cause mental health problems in some individuals, ranging from minor emotional stress to clinical mental illness. People who have lived in Colstrip about 4-6 years have been experiencing these problems more than recent newcomers or long-time residents (Eric Deeter, oral commun., July 30, 1980). According to Deeter, the rate of reported mental health problems in Colstrip is one-fourth to one-half larger than the rate in Forsyth or Miles City, but less severe than in some energy boom towns such as Rock Springs or Gillette. This is due to efforts by Montana Power Company (which owns Colstrip) and government agencies to provide adequate housing, schools, health facilities, human services, law enforcement, and some recreational amenities.

The relatively high wages earned by mine employees enables them to keep up with price inflation more easily than most long-time residents, those on fixed incomes, and others residents not employed in the mining industry. Feelings of relative economic deprivation may occur among those not sharing in the prosperity.

f. Trends

Cumulative effects from construction of generating units 3 and 4 and expansion of both the Rosebud and Big Sky mines will significantly affect the quality of life in the Colstrip-Forsyth area whether or not mining in Area E continues. Cumulative impacts of mining and power generation are discussed in volumes 1 and 3 of FES 80-1 (U.S. Department of the Interior and Montana Department of State Lands, 1980) and are summarized below.

Colstrip's population is expected to be 5,000 in March, 1981, peaking at 8,000 in 1983 at the height of construction, and stabilizing at 5,000 by 1985, assuming no new generating units or large mines are built after then (Pat Reardon, Sunlight Development Corp., oral commun., July 17, 1980).

Rosebud County's population is projected to reach nearly 14,000 by 1990, an increase of over 40 percent from 1979. Most of this projected growth would be due to the construction and operation of Colstrip units 3 and 4 and the projected expansion of the Rosebud mine needed to provide coal for the new generating units. During the years of most rapid growth, local government, formal and informal institutions, and social networks in Colstrip and Forsyth would not be able to meet the demands placed on them, according to FES 80-1.

The loss of more personal service and slow pace of life generally possible in small towns such as Forsyth and Colstrip would lead to continued dissatisfaction and stress among many individuals. According to Gold (1975), "[t]hese stresses and the dissatisfaction they cause may be translated into additional abusive behavior, mental illness, alcoholism, and crime, with consequent impacts on its victims."

The proportion of Colstrip residents experiencing alcohol, drug abuse, and mental health problems will likely increase as large numbers of workers arrive to build Colstrip generating units 3 and 4. Colstrip residents would continue to be exposed to levels of atmospheric particulate which exceed the Federal primary air quality standard established to protect human health. Resultant health problems are a possibility. Residents of Colstrip will also continue to be exposed to noise levels which exceed U.S. Environmental Protection Agency guidelines established to protect human health and welfare. According to the U.S. Department of the Interior (1979), noise levels in Colstrip from the existing generating units range from 59 to 68 dBA (L_{dn} values--night readings weighted), which exceed the 55 dBA level recommended by the EPA (cited in U.S. Department of the Interior, 1979) for the protection of public health and welfare.

Mine employees and their families would continue to benefit from employment with Western Energy. Area businessmen (mostly in Forsyth) would benefit from business generated by mine employees. There are few businesses in Colstrip.

Residents of Colstrip would continue to experience strained services and facilities (such as recreation) and the lack of some services (such as a hospital).

3. Impacts of the Proposal

See summary of impacts. The primary effect would be to continue Area E's relatively small contribution to the existing social impacts discussed above. This is essentially the same conclusion as was reached in the 1977 EIS on Area E.

4. Mitigating Measures

Western Energy could initiate a study of social groups in the Colstrip-Forsyth area such as family, church, government, volunteer groups, etc., which would allow more complete predictions of impacts. This, in turn, would allow local agencies to plan for those impacts and take measures to reduce their severity. The Department of State Lands does not have the authority to require such a study.

I. ECONOMICS

1. Summary of Impacts

Approval of the Area E extension would not have a significant adverse economic impact because the mine is an existing operation that provides a tax base for Rosebud County and the two Colstrip school districts.

2. Description of the Existing Environment

a. Employment and Income

Total employment in Rosebud County changed little between 1950 and 1970, averaging 2,100-2,200 jobs. The steady decline in agricultural employment was generally offset by a contemporaneous increase in public sector, trade, and service jobs.

The reopening of the Rosebud mine by Western Energy in 1968 began to change the structure of the economic base of Rosebud County. The base became increasingly dominated by jobs directly associated with the mining and conversion of coal (table II-11). Mining in Area E now provides about 58 jobs and has been an integral but minor part of this process. The construction of Colstrip generating units 3 and 4 will be the dominant force for employment change in the county for the next 4 years.

Unemployment rates in the county were substantially lower than the State figure during the construction of Colstrip units 1 and 2 from 1971 to 1975. During the 4-year period starting in 1976 (after construction was finished) unemployment in the county was much higher than during construction. In 1977 and again in 1979, the county's unemployment rate was higher than the State's rate.

Not all county residents benefited to the same degree from the increased employment opportunities during the first half of the decade. The unemployment rate on the Northern Cheyenne Indian Reservation, even during the height of construction, was much higher than in the surrounding area (table II-12).

Between 1950 and 1970 total personal income increased at a slower rate than the State's. By 1970 the county's per capita income figure had lost 9 points to the State, decreasing from 93 percent to 82 percent of the State average. Although there were some exceptional years associated with high construction income, the per capita income continued to grow at a generally slower rate after 1970. By 1977 per capita income in Rosebud County was $4,528--74 percent of the State average (see table II-13).

The slow growth of per capita income in the county during 1970-77 was generally the result of several bad years in the agricultural sector. Farm proprietors suffered, on average, net losses in 1975, 1976, and 1977 (table II-14).

TABLE II-11.--Employment by broad industry and sector in Rosebud County, 1972-1977

[Source: U.S. Department of Commerce, 1979]

	1972	1973	1974	1975	1976	1977
Agriculture[1]---------	682	668	681	623	591	547
Mining----------------	104	269	283	392	416	403
Manufacturing--------	265	192	180	160	146	52
Federal government---	173	174	204	226	221	222
Construction (part)[2]-	0	0	0	1,058	400	115
TCU[3] (part)[4]---------	25	12	11	0	0	7
Total economic base-	1,249	1,315	1,359	2,459	1,774	1,346
Trade-----------------	269	312	346	411	425	367
FIRE[5]----------------	37	43	49	50	61	61
Services[6]------------	798	845	916	1,221	1,249	1,235
Construction (remain)	39	76	180	296	259	230
TCU[3]-----------------	167	181	201	210	226	231
Local and State government---------	367	402	466	549	559	574
Total ancillary---	1,677	1,859	2,158	2,737	2,779	2,698
Total employment-----	2,926	3,174	3,517	5,196	4,553	4,044

[1] Farm proprietors plus farm wage and salary.
[2] Proportion greater than .0569 of total employment.
[3] Transportation, communications, and utilities.
[4] Proportion greater than .0571 of total employment.
[5] Finance, insurance, and real estate.
[6] Includes: other industry wage and salary and nonfarm proprietors.

TABLE II-12.--Unemployment rates, 1970-1979 (percent)

[Sources: Montana Department of Labor and Industry, 1980; U.S. Department of the Interior, 1970-1980]

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Rosebud Co.	3.1	3.0	3.2	3.2	3.6	3.3	5.8	6.9	5.9	5.2
N. Cheyenne Indian Res.*	NA	36.0	27.0	25.0	NA	40.0	43.0	37.0	45.0	34.0
Montana	4.3	4.8	4.8	4.8	5.2	6.4	6.1	6.4	6.0	5.1

*Unemployment rate is defined slightly differently and tends to overestimate unemployment relative to the other method.

TABLE II-13.--Per capita personal income, selected years 1950-77 (current dollars)

[Source: U.S. Department of Commerce, 1979]

	1950	1959	1970	1972	1973	1974	1975	1976	1977
Rosebud Co	$1,510	$2,077	$2,768	$3,224	$4,503	$4,180	$5,409	$4,992	$4,528
Montana	1,622	2,010	3,395	4,013	4,760	4,976	5,381	5,648	6,093
Rosebud/ Montana	0.93	1.03	0.82	0.80	0.95	0.84	1.01	0.88	0.74

The most recent personal income figures reflect the county's increasing dependence on coal-related employment. In 1977 nearly one-fourth of the personal income in Rosebud County directly resulted from mining. Much of the construction and transportation sector wages were also a result of coal development.

b. External costs

Coal development in the Colstrip area has had effects which are not reflected in the mining firms' costs. These "external costs" are difficult to measure, but if they could be measured they might be higher than known costs such as for facilities and services (Old West Regional Commission, 1979). External costs of coal mining (of which Area E contributes a small part) include:

- The option value of the coal mined, which is the value of retaining the coal for future use instead of consuming it now.
- Human health effects resulting from increases in air, water, and solid waste pollution.
- Objective changes which have socioeconomic effects, such as increased congestion costs in public facilities and services and increased incidence of personal injury and property damage crime resulting from growth; adverse economic effects during the post-development period; mental health effects of environmental degradation and increased stress; localized inflation in the cost of living, particularly in housing costs; and increases in travel time, accident rates, and recreation costs due to congestion associated with growth.
- Subjective changes which have socioeconomic effects, such as a deleterious alteration of the perceived quality of life caused by industrial intrusion, community expansion and change, and changes in the work and social environment.

TABLE II-14.--Personal income in Rosebud County by major sources, 1972-77 (thousands of dollars)

[Source: U.S. Department of Commerce, Regional Economics Information System, Bureau of Economic Analysis, Unpublished Table, April, 1979]

Item	1972[1]	1973[1]	1974[1]	1975[2]	1976[2]	1977[2]
Total labor and proprietors income by place of work[3]						
By type						
Wage and salary disbursements	12,556	17,079	21,911	50,598	41,457	36,572
Other labor income	882	1,448	1,854	4,050	4,030	3,958
Proprietors income[4]	3,943	8,529	4,357	1,953	1,683	2,018
Farm	2,165	6,520	2,397	-158	-506	-589
Non-farm[4]	1,778	2,009	1,960	2,111	2,189	2,607
By industry						
Farm	3,727	8,326	4,568	1,814	1,215	949
Non-farm	13,654	18,730	23,554	54,787	45,955	41,599
Private	10,405	15,031	19,057	49,005	40,066	34,747
Ag. serv., for., fish., and other[5]	146	119	128	152	333	211
Mining	1,285	4,279	4,914	8,291	10,237	10,575
Construction	534	1,020	3,389	26,952	14,794	8,969
Manufacturing	1,347	1,117	1,239	1,198	938	595
Non-durable goods	908	676	689	681	677	237
Durable goods	439	441	550	517	261	358
Transportation and public utilities	2,171	2,489	2,882	3,030	3,593	4,064
Wholesale trade	218	256	294	454	482	472
Retail trade	1,488	1,877	2,002	2,555	2,659	2,546
Finance, insurance, and real estate	275	312	375	404	585	638
Services	2,941	3,562	3,834	5,969	6,445	6,677
Government and government enterprises	3,249	3,699	4,497	,782	5,889	6,852
Federal, civilian	1,240	1,365	1,638	2,047	1,746	2,267
Federal, military	81	90	110	139	143	155
State and local	1,928	2,244	2,749	,596	4,000	4,430
Total labor and proprietors income by place of work	17,381	27,056	28,122	56,601	47,170	42,548
Less: personal contributions for social insurance by place of work	721	1,066	1,371	3,127	2,505	2,139
Net labor and proprietors income by place of work	16,600	25,990	26,751	53,474	44,665	40,409
Plus: residence adjustment	-1,020	-1,466	-1,912	-10,841	-6,441	-4,976
Net labor and proprietors income by place of residence	15,640	24,524	24,839	42,633	38,224	35,433
Plus: dividends, interest, and rent[6]	2,508	3,338	4,309	5,149	5,877	6,623
Plus: transfer payments	2,546	3,013	3,565	4,426	5,246	5,500
Personal income by place of residence	20,694	30,875	32,713	52,208	49,347	47,556
Per Capita Personal Income (Dollars)	3,224	4,503	4,180	5,409	4,992	4,528

[1] Estimates based on 1967 SIC.

[2] Estimates based on 1972 SIC.

[3] Consists of wage and salary disbursement, other labor income, and proprietors, income. Primary source for private non-farm wages: ES-202 covered wages--Montana Employment Security Commission.

[4] Includes the capital consumption adjustment for non-farm proprietors.

[5] Includes wage and salaries of U.S. residents working for international organizations.

[6] Includes the capital consumption adjustment for rental income of persons.

- Esthetic losses and increased noise.
- Social impacts due to the physical, social and political changes in the affected communities.
- Loss of archaeological and/or historical sites.

Some of these costs are borne by future generations as well as by people living near the active mine. The traditional means of including external costs in private costs is through taxation (Old West Regional Commission, 1979). Because of the difficulty in measuring external costs it is not known how well tax revenues satisfy external costs.

c. Fiscal conditions

Recent coal development in Rosebud County has had a major effect on the fiscal structure of Rosebud County. The taxable value associated with the gross proceeds of the Western Energy and Peabody mines and the Colstrip generating units has become the major source of the county's taxable value. In 1970 the two categories represented less than one-fifth of the taxable value; by 1978, they exceeded three-fourths. This rapid growth in taxable value--nearly sevenfold between 1970 and 1978--is largely responsible for the decline in the county's tax rate, which fell from 54.55 mills in fiscal year 1971 to 26.632 mills in fiscal 1979. The 1979 rate for Rosebud County was very low compared to the State average of 44.8 mills.

The coal production in Area E has been a small but integral part of the fiscal effects of coal development in Rosebud County. In fiscal 1979, coal production from Area E represented perhaps 5 percent of the county's taxable value. Most of the growth in taxable value has come from the generating units (41 percent of the growth), an 18-fold increase in coal production accompanied by a tax law change (26 percent), and substantial increases in both the amount of oil and the wellhead price of oil produced in the county (21 percent).

The growth in taxable value has occurred primarily near Colstrip and therefore has also benefited the Colstrip school districts: in 1979, the mill levy for High School and Elementary Districts 19 was 62 mills, compared to an average 122 mills statewide.

Coal development has not helped all taxing jurisdictions in Rosebud County. The total mill levy in Forsyth (the school, city, and county levies) has remained relatively constant, because the additional revenues needed to accommodate coal-induced growth has largely offset the reduction in the county's tax rate. The total levy in Forsyth has remained near the statewide average.

Additional information on fiscal conditions in Rosebud County is found in chapter 7 of the Rosebud County Planning Data Book (Rosebud County Planning Board, 1979).

Since 1975, three sources of revenue based on the contract sales price of coal have been available in Montana: the resource indemnity trust tax, the gross proceeds tax, and the coal severance tax. The taxes are based on the contract sales price, which is defined as the f.o.b. mine price less property, severance, and resource indemnity trust taxes charged to the seller.

The resource indemnity trust tax is an annual tax of $25 plus 0.5 percent of the contract sales price revenue in excess of $5,000 that is received from the sale of all minerals, including coal, extracted from the State. Income from the interest raised by the trust account based on this tax was available to and used by the State for the first time in fiscal year 1980. The gross-proceeds tax is an _ad valorem_ property tax. Each taxing jurisdiction applies its mill levy against the taxable value of the coal, i.e., 45 percent of the contract sales price.

The coal severance tax is 30 percent of the contract sales price and is collected by the State for use as shown in Appendix I-1. The dedication of a portion of the mineral taxes to permanent trust funds provides a long term flow of revenue that will benefit not only current State residents but also partially compensate future generations for the loss of a nonrenewable resource. Taxes now collected from Area E are shown in table II-15. In 1979 the severance tax was responsible for about $2.59 of the average Montana Power residential customer's annual cost of $234.80. The tax represented about 1.1 percent of the total annual bill, which equals the highest percentage paid by the residential customers of all other utilities which bought Montana coal in 1979 (Appendix I-2).

3. Impacts of the Proposal

The employment in Area E would continue to provide a small and decreasing portion of total personal income in Rosebud County--somewhat less than the 3.5 percent the mine contributed in 1977. For the next 4 years, the construction of generating units 3 and 4 will dominate the income picture in Rosebud County. Mining at Area E will end in 1984; projected (but not yet permitted) mining at Area D would continue the existing employment at Area E for at least 2 decades.

Over the next 4 years, Area E would contribute a declining proportion of the taxable value in Rosebud County and School Districts 19, primarily because of the addition of Colstrip generating units 3 and 4 to the tax base and the projected increases in total coal production over the next 4 years. If the price of Area E coal continues to go up at a slower rate than other Western Energy coal (between 1975 and 1979 the contract sales price of all Western Energy coal went up by 33.6 percent, while coal from Area E increased by 28.3 percent), this would also tend to reduce the mine's relative contribution.

Area E would continue to be responsible for a small and declining share of the total external costs of coal development in the Colstrip area (see section 2, Description of the Existing Environment).

TABLE II-15.--Public revenues generated by Area E, 1980-84

[Thousands of constant 1979 dollars. Source: Appendix I-2.]

Year	Production (thousands of tons)	Prices		Federal revenues			State revenues		Local government revenues
		f.o.b.[1]	C.S.P.[2]	Royalties[3]	Abandoned Mine Reclamation[4]	Black Lung[5]	Severance Tax[6]	R.E.I.T.[7]	Gross Proceeds[8]
1980	5,436	$5.740	$3.910	$1,509.9	$1,902.6	$624.0	$6,376.0	$106.3	$ 908.6
1981	1,627	7.380	5.108	2,521.5	569.5	240.1	2,493.2	41.6	355.3
1982	3,164	7.235	5.003	4,566.2	1,107.4	457.8	4,748.2	79.1	676.6
1983	3,295	7.270	5.028	4,840.6	1,153.3	479.1	4,970.1	82.8	708.2
1984	3,069	7.130	4.925	4,149.0	1,074.2	437.6	4,534.7	75.6	646.2
Total	16,591			17,587.2	5,807.0	2,238.6	23,122.2	385.4	3,294.9

[1] f.o.b. = freight on board, gross market value of each ton of coal, a weighted average taking differential royalties into account.

[2] C.S.P. = Contract Sales Price, the f.o.b. price less production taxes, a weighted average taking differential royalties into account.

$CSP = FOB - 0.35 - (0.02)FOB - (0.3)CSP - (0.005)CSP - (0.043)CSP$ or $FOB = 1.35CSP + \$0.46$

[3] Coal produced from lease Billings 020989-038770 has a royalty rate of $0.15 per ton. Coal produced out of lease M-035735 is at 21 percent of the f.o.b. price ($1.55 per ton). Table II-16 summarizes production by lease.

[4] $0.35 per ton.

[5] 2 percent of the f.o.b. price.

[6] 30 percent of the C.S.P.

[7] R.E.I.T. = Resource Indemnity Trust tax, 0.5 percent of the C.S.P.

[8] Assumes a tax rate of 95 mills. Applied to a taxable value of 45 percent of the C.S.P.

Tax revenues would increase because of an increase in Federal royalties. Federal royalties are a component of the contract sales price (CSP) which is the basis for the Montana coal severance tax and local production taxes. In 1980, the Federal royalty rate on a portion of the coal produced from Area E (table II-16) will go up to 21 percent of the f.o.b. price from the current flat rate of 15 cents/ton; State and local production taxes that use the CSP as a base will increase proportionately (Appendix I-3). The increase in the CSP will cause the Montana severance tax to increase to $1.53/ton of Area E coal. If passed on to the consumer, these tax increases would increase the average annual Montana Power Company residential utility bill by about $.60 in 1980, $4.40 in 1981, and slightly less than $4.40 from 1982 through 1984 (Appendix I-3).

TABLE II-16.--Area E coal production by lease, 1980-84

[Data are in thousands of tons. Source: Sherry Schwend, Western Energy Company, written commun., September 9, 1980.]

Year	Total Production	Federal Lease Billings 020989-039770	Federal Lease M-035735	Burlington Northern Lease
1980	5,436*	2,389	743	2,304
1981	1,627**	-----	1,627	-----
1982	3,164	241	2,923	-----
1983	3,295	190	3,105	-----
1984	3,069	125	2,665	279
Total	16,591	2,945	11,063	2,583

*2,227,000 tons would be hauled to the Area A & B facilities to meet contracts of Area B.

**1,600,000 tons would be hauled from Area B to Area E to meet contracts of Area E.

J. COMMUNITY SERVICES

1. Summary of Impacts

Continued mining in Area E would not increase the need for community services in Rosebud County. Services and facilities provided in response to construction of Colstrip generating units 1 and 2 are generally adequate for the population attributable to Area E; construction of generating units 3 and 4 has required substantial expansion of most services and facilities.

2. Description of the Existing Environment

Much of the information in the following discussion is from the Planning Data Book and Comprehensive Plan (Rosebud County Planning Board, 1979), which contains extensive additional information on community services in Rosebud County.

a. Housing

The final EIS on Areas A and E (Montana Department of State Lands, 1977) stated that housing demand had eased following the construction of generating units 1 and 2. Housing is once again in short supply because of the large increase in population accompanying construction of units 3 and 4. Sunlight Development Corp., a Montana Power Company subsidiary which provides most of the housing in Colstrip, did not have funding to construct housing until November, 1979, when units 3 and 4 were authorized. One of the most serious problems in developing new housing in Rosebud County is the lack of good information concerning groundwater availability for domestic use (Eldon Rice, Rosebud County Planner, oral commun., April 18, 1980). The quality of existing housing also needs to be improved: about 80 percent of the single family residences in the county are below the State average, according to the Montana Department of Revenue grading system.

b. Water system

Much work has been done on area water systems since the final EIS on Areas A and E was prepared. Colstrip, Forsyth, and Ashland each have an adequate water supply at present. Lame Deer will need to expand the existing system as the population increases. Some Area E miners live in Lame Deer, but as with Colstrip and Forsyth, their numbers are not expected to increase.

c. Waste disposal

Rosebud County is now a member of the Tri-County Solid Waste Program. The landfill dumps in Forsyth and Ashland were closed and replaced with garbage canisters which are emptied and the garbage compacted and hauled to a landfill near Billings. Colstrip continues to use an old mining pit for its dump. Lame Deer still uses its landfill dump.

Colstrip, Ashland, Forsyth, and Lame Deer now have adequate sewer capacity.

d. Police protection

As described in the 1977 EIS, law enforcement is provided by the County Sheriff's Office for all of Rosebud County excluding the Northern Cheyenne Indian Reservation. One sheriff, an undersheriff, and 12 deputies patrol this area with 10 cars. According to the former U.S. Bureau of Reclamation (U.S. Department of the Interior, 1977), the number of patrol cars is adequate but the number of personnel is barely adequate.

e. Fire protection

There has been little change in the volunteer fire departments that serve Colstrip, Ashland, Forsyth and Lame Deer since the previous EIS was written. The insurance rating for Forsyth has improved from Class 7 to Class 5 because the city rebuilt the municipal water system. Most of the Rosebud County's rural residents lack a rural fire district to provide fire protection.

f. Library

The Sagebrush Bookmobile Service now covers all of Rosebud County, stopping at Forsyth, Lame Deer, Colstrip, and Ashland. The Forsyth Library (20,000 volumes) is still the only one in the county. It is adequate for the county's population, according to the guidelines of the Public Library Association (1962).

g. Communication

One local radio station continues to serve Rosebud County. Six T.V. channels can be received in Forsyth via cable. The weekly Forsyth Independent and daily Billings Gazette provide news to area residents.

h. Welfare services

Welfare services in Rosebud County are provided by the Montana Department of Social and Rehabilitation Services. Rosebud County appears to be adequately staffed with 3 social workers and one public health nurse, who work out of full-time offices in Forsyth and Lame Deer (FES 80-1--U.S. Department of the Interior and Montana Department of State Lands, 1980). Services for the aged are provided in a new center in Forsyth and a small center in Ashland.

i. Schools

New elementary schools have been build in Colstrip and Forsyth, a new middle school in Forsyth, additional classrooms and a gymnasium in Ashland, and a high school in Colstrip. Schools in Colstrip and Forsyth should be able to handle the additional pupils that will arrive with the construction of units 3 and 4. The Dull Knife Memorial College on the Northern Cheyenne Indian Reservation is expanding its facilities.

j. Health facilities

Colstrip now has a medical and dental clinic and a 24-hour ambulance service. Forsyth's hospital is critically understaffed with physicians, especially specialists; many Rosebud County residents travel to Miles City and Billings for specialized care. This is a common situation in rural Montana counties. Forsyth's emergency medical service (which also includes a 24-hour ambulance) has been greatly improved with new equipment and training programs. Forsyth also has a dentist and part-time optometrist. A counseling psychologist provides services to residents of Forsyth, Colstrip, Ashland, and the Northern Cheyenne Reservation.

Even though a full-time psychologist will begin working in Colstrip in September, the mental health service is understaffed (Jim Peterson, Assistant Director, Eastern Montana Region 1 Community Mental Health Service, oral commun., August 5, 1980). There is no longer a social worker in Ashland, and a mental health nurse no longer makes calls in Rosebud County.

3. Impacts of the Proposal

The final EIS on Areas A and E (Montana Department of State Lands, 1977) anticipated no social service impacts from the extension of ongoing mining into Areas A and E. That prediction has been borne out, largely because improvements made in response to the population influx accompanying construction of generating units 1 and 2 were generally adequate for the smaller population that remained once the units were completed. Similarly, the impacts on community services caused by continued mining in Area E would not be measurable. The population attributable to Area E would continue to contribute a only small amount to the need for facilities and services. The community services required to serve the population influx accompanying the construction of generating units 3 and 4 would vastly outweigh the demands generated by the 180 people attributable to Area E operations. Health care and recreation facilities will continue to be the most-stressed community services.

Due to delays in the construction of generating units 3 and 4, the greatest strain on services will occur about 1983 instead of 1980 as stated in the final EIS on Areas A and E. This delay provided additional time to expand local services (especially health services) in preparation for the population influx accompanying construction.

K. LAND USE

1. Summary of Impacts

The Area E extension would not signficantly affect land use in Rosebud County, because mining the 410 acres of rangeland would temporarily reduce available grazing land in Rosebud County by only 0.02 percent. If managed properly by the landowner or grazing lessee, the reclaimed mine area would be about as productive as it was in 1975, the last year it was grazed.

2. Description of the Existing Environment

The land use pattern and the productivity of the land on the 450 acres of the proposed Area E extension is similar to that found in the rest of the Western Energy leasehold, Rosebud County, and southeastern Montana. All but about 28 acres of the 450 acres (94 percent) were being used for rangeland when Area E opened (table II-17). In comparison, rangeland uses make up 67 percent of the Western Energy leasehold, 78 percent of Rosebud County, and 74 percent of the 45-million-acre Yellowstone River subbasin (Rosebud County Planning Board, 1979). In 1975, rangeland in the Area E extension had a productivity of about 0.26 animal unit months (AUMs)/acre, or 62 percent of its potential 0.42 AUMs/acre. Because it has not been grazed since 1975, its current productivity is probably somewhat higher than 0.26 AUMs/acre, but still within normal for southeastern Montana--0.25 to 0.30 AUMs per acre. Under optimum management, the rangeland of the Area E extension has the potential to support about 18.9 cow-calf units for a 10-month grazing period, based on the potential stocking rate of .42 AUMs/acre. That stocking rate would generally produce about 9,400 pounds of yearlings/year.

Mining in Area E before 1968 disturbed about 260 acres, all of which have been regraded and revegetated. Since 1968, about 950 additional acres have been disturbed. About three-fourths of of the 950 acres are being reclaimed (see table II-17). Because modern reclamation in the northern Great Plains has been undertaken only in the last 5 years, the potential long term productivity of Area E is not known. Section 3 (impacts) discusses probable short-term vegetative productivity on the reclaimed portions of Area E based on current reclamation experience.

The cumulative land use impacts of recent coal development in Rosebud County have been principally confined to the Colstrip and Forsyth vicinities and the transportation corridor between the two towns. About 3,550 acres of agricultural land have been temporarily displaced by mining (3,350 acres of rangeland and 200 acres of cropland). Although lands now being mined must be reclaimed, projected new mining will probably increase the total amount of land out of range production at any one time. About an additional 550 acres in Colstrip and Forsyth have been permanently devoted to urban and industrial uses during the same time (Montana Department of State Lands, 1980). The cumulative impacts of coal mining to date represent 0.1 percent of Rosebud County's 2.5 million acres of range and pasture land and 0.2 percent of the nearly 130,000 acres of crop land.

TABLE II-17.--Western Energy land use summary

	Premining			Current Conditions			Expected Condition 1/1/85		
	Rosebud Mine	Total Area E	Area E Extension	Rosebud Mine	Total Area E	Area E Extension	Rosebud Mine	Total Area E	Area E Extension
Undisturbed									
Crops	1,420	0	0	1,220	0	0	1,000	0	0
Ponderosa pine	7,440	28	28	7,290	28	28	6,900	28	18
Rangeland	16,500	1,845	422	14,683	898	422	16,143	672	12
Subtotal	25,360	1,873	450	23,193	926	450	24,043	700	30
Disturbed									
Active mining, spoils, and highwall reduction	640	260	0	315	161	0	300	0	185
Facilities & haul roads	0	0	0	395	40	0	300	40	10
Associated disturbance	0	0	0	29	20	0	100	20	0
Reclamation	0	0	0	2,011	986	0	1,200	1,373	225
Subtotal	640	260	0	2,750	1,207	0	1,900	1,433	420
Bond Release									
Crops	0	0	0	0	0	0	0	0	0
Ponderosa Pine	0	0	0	0	0	0	0	0	0
Rangeland	0	0	0	0	0	0	0	0	0
County Road	0	0	0	57	0	0	57	0	0
Subtotal	0	0	0	57	0	0	57	0	0
Total	26,000	2,133	450	26,000	2,133	450	26,000	2,133	450

Note: there are about 440 acres of unreclaimed spoils remaining from the original Northern Pacific mine. There are 380 acres in Western Energy's Area D designated Abandoned Mine Land by the U.S Department of Agriculture Soil Conservation Service and 60 remaining acres of Burlington Northern spoils along the railroad right-of-way. The 260 acres in Area E have been regraded and revegetated by Western Energy and Montana Power Company.

3. Impacts of the Proposal

Given adequate management, the postmining vegetative productivity of the reclaimed surface would not be measurably lower than the normal premining productivity. For the short term (5 to 7 years after reclamation begins), vegetative productivity on the better sites may increase sharply above premining levels, due to fertilization and to the release of nutrients following disturbance of the soil. As the released nutrients are taken up in vegetation, an equally rapid decline will probably follow. A gradual increase in productivity would probably then occur as nutrients are returned to the soil (FES 80-1, Volume 1, Chapter 4, Soils and Vegetation). Actual postmining productivity under normal management will probably be equal to or greater than levels actually achieved before mining. Further discussion is found in the Soils and Vegetation sections.

Mining and initial reclamation would preclude normal livestock grazing practices on about 225 acres of Area E until 1985 (table II-17); the remaining reclamation would further preclude normal ranching operations until bond release (a minimum of 10 years), although some grazing to demonstrate reclamation success would take place (see table II-17). During this next 5-year period, the entire Western Energy Rosebud mine, the Big Sky mine, and Colstrip generating units 1-4 would displace livestock grazing on about 5,900 acres--less than 0.2 percent of the available grazing land in Rosebud County. Although almost all of the displacement would be temporary, the construction and operation of Colstrip units 3 and 4 would result in about 890 acres being permanently devoted to urban and industrial uses, mostly in Colstrip but perhaps as many as 40 acres in Forsyth, where some of the workers would live (Montana Department of State Lands, 1980). Area E would not measurably contribute to this additional urban and industrial land use because the number of workers at Area E would not increase over the remaining 5 years of the mine.

L. TRANSPORTATION

1. Summary of Impacts

The Area E extension would not contribute significantly to the existing highway safety problems and occasional traffic delays from coal trains in the Colstrip-Forsyth area. Improvements to FAP 39 projected to be completed by 1982 should greatly alleviate both problems.

2. Description of the Existing Environment

a. Roads

Almost all people in the sparsely-populated Colstrip area travel by road. The road network, although not well developed, was generally adequate for the pre-development population. The main highway linking Colstrip with Forsyth and Lame Deer has been heavily used when mines and generating units were under construction.

Graveled county roads and two-lane State highways (fig. II-7) service the Colstrip area. Federal Aid Primary (FAP) 39 connects Colstrip with Interstate 94, the major east-west highway, to the north, and with FAP 37 (U.S. 212), a heavily used east-west highway, to the south. FAP 39 currently has 4 railroad crossings. It was designed and constructed about 30 years ago to serve as a secondary road servicing the agricultural community in the area. The highway has deteriorated over the years and is not suitable to convey the volumes of traffic caused by coal development.

The Montana Department of Highways is in the process of reconstructing 31 miles of FAP 39. A 7-mile section south of the intersection with I-94 has been completed. A contract for a 5.8-mile section was let in August of 1980. The contracts for the remaining sections are currently scheduled to be let in August and December of 1981. Assuming availability of funds and cooperative weather, the entire project could be completed by late 1983. The reconstruction consists of widening the roadway, resurfacing, realignment where needed, and railroad structures to provide grade separations at the places where FAP 39 and the Colstrip railroad spur intersect between I-94 and Colstrip.

FAP 37, which intersects FAP 39 at Lame Deer, leads west to Busby, Crow Agency, and Hardin and east to Broadus (fig. II-7). Heavily used by trucks, this two lane road presents dangerous driving conditions. The Department of Highways is currently planning to let contracts to reconstruct 27 miles of FAP 37 between Crow Agency and Busby in June and December 1981 and June 1982. Assuming that the contracts are let on schedule and the needed funds are available, these projects could be completed by late 1983.

Traffic on the major highways leading to Colstrip has increased considerably since mining resumed at Colstrip (table II-18). Traffic on FAP 37 increased about 60 percent from 1968 to 1978. Traffic on FAP 39 from Colstrip to Interstate I-94 increased about 220 percent from 1968 to 1978. This increase, combined with the current poor condition of the highway, the severity of the accidents that have occurred, and the four railroad crossings, has resulted in the Montana Department of Highways rating FAP 39 extremely unsafe--1 on a scale of 20 (Montana Department of Highways, 1978). The reconstruction projects scheduled for the road should make the highway as technically safe as any other two-lane highway in the State, although the driving habits of persons using the road would continue to play a major role in the road's accident rate.

During 1980, 1,321,700 tons of were hauled from Area E across FAP 39 to the Area A and B loadout facilities to help met the existing contracted requirements of Area B. Until a permit for Area E is issued, a reverse flow from the newly permitted portion of Area B would be needed to help meet contract requirements of Area E. Moving coal from Area B to Area E would require about 9.5 crossings/daylight hour on a yearly average basis. Because coal traffic is stopped when there is traffic on FAP 39, delays have not occurred and none are expected. Human error could cause a serious accident, although the potential for this is low.

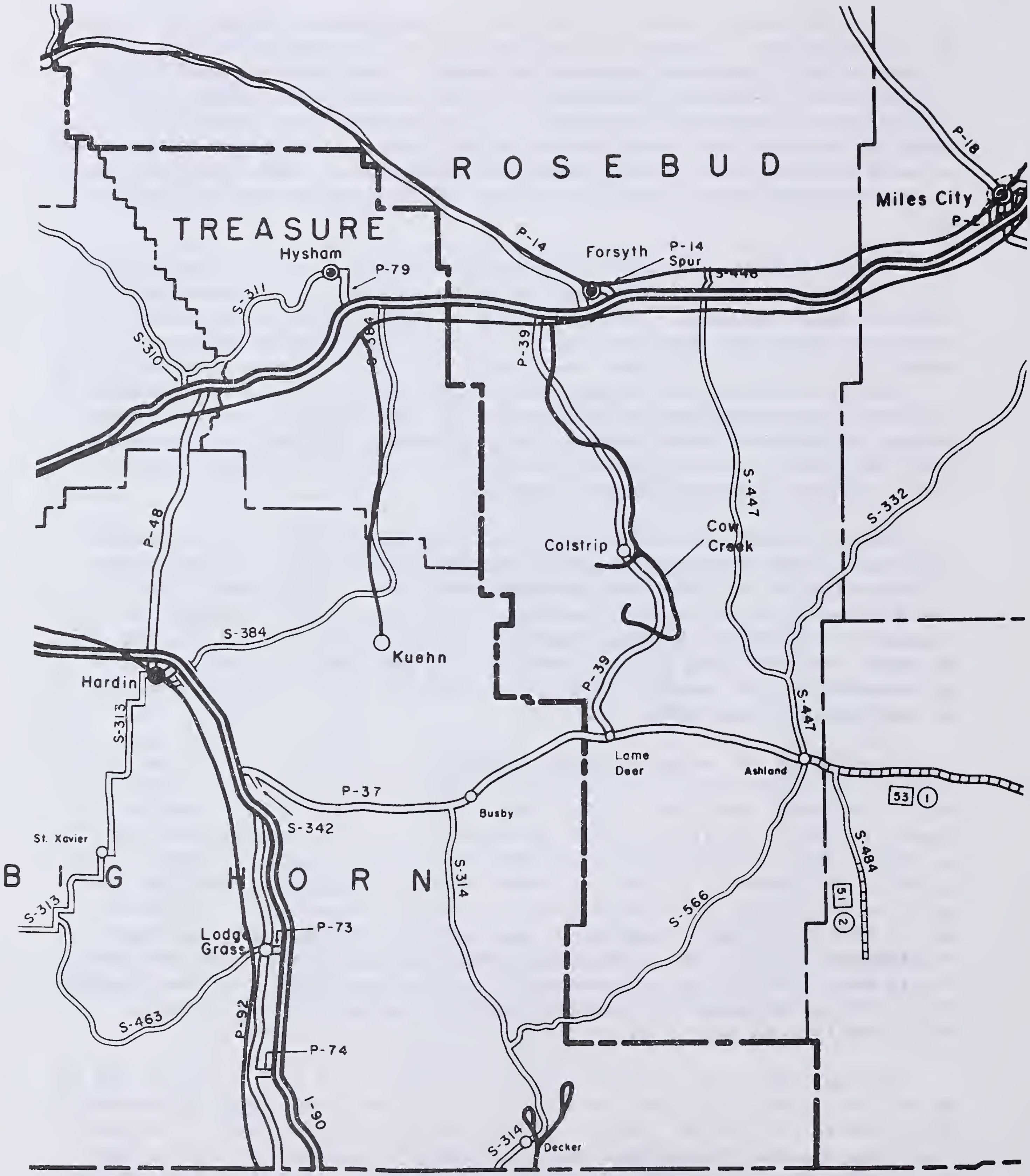

FIGURE II-7.--Transportation routes near Colstrip.

TABLE II-18.--Average daily traffic counts for highways near Area E, 1968-1978

[Source: Bob Keck, Montana Department of Highways, written commun., October 1979]

Highway segment	Year										
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FAP 37											
Jct. 342 to Busby..........	673	603	657	701	766	860	778	791	1,052	1,443	1,159
Busby to Rosebud County line..............	782	773	802	766	854	924	914	1,072	1,223	1,585	1,153
Rosebud County line to Lame Deer............	858	850	863	820	962	1,033	1,011	1,263	1,243	1,800	1,370
FAP 39											
Lame Deer to Reservation boundary................	238	274	320	363	395	---	---	---	359	511	585
Reservation boundary to Colstrip............	159	170	195	203	269	508	451	498	388	344	364
Colstrip to I-94 interchange............	210	190	236	253	370	1,193	1,047	1,425	1,087	783	678

b. Railroads

A railroad spur connects Colstrip to the mainline of the Burlington Northern (BN) about 25 miles to the north near Nichols (fig. II-7). The spur serves both the Western Energy's Rosebud mine and Peabody's Big Sky mine 7.5 miles south of Colstrip. Although most of the coal from the Rosebud mine is shipped out of state--mainly to Minnesota and Wisconsin--only about 20 percent of the production from Area E leaves Colstrip.

Montana Power's Corette plant in Billings receives about 680,000 tons of coal/year from Area E. An average of 37 loaded unit trains/week used the Colstrip spur during 1979. This amounts to 74 trips/week counting returning empty trains. The trains used to ship coal to Billings have 60 cars instead of the average 100 cars, so Area E contributed about 6 percent of the total coal train traffic. On rare occasions the Colstrip spur is used to haul heavy machinery for construction projects; otherwise, only coal is hauled on the spur.

3. Impacts of the Proposal

Impacts on transportation from the Area E extension would not be significant: road traffic associated with the mine would not exceed projected highway capacity; rail capacity would not be affected because coal production at Area E would not be increased and only about 20 percent of the Area E production is shipped out of Colstrip.

By 1983 the average daily traffic on FAP 37 between Colstrip and I-94 will be about 1,300 vehicles/day, an increase of more than 80 percent over the 1978 figure. The road's capacity could be exceeded until the improvements scheduled by the Montana Department of Highways are completed. The increased traffic will be almost entirely due to the construction of Colstrip generating units 3 and 4. The Area E extension would not contribute to the increase, but does represent perhaps as much as 3 percent of the current daily traffic.

During the 1980's, rail traffic on the Colstrip spur would more than double. This would not exceed the spur's capacity. Area E's relative contribution would decline from its current 6 percent level as total traffic increased and Area E traffic remained constant.

M. RECREATION

1. Summary of Impacts

Continued mining at Area E would not significantly increase demands on developed recreation facilities or undeveloped recreation areas. The minesite itself is not a significant recreation resource.

2. Description of the Existing Environment

a. Urban recreation resources

Outdoor recreation facilities in Forsyth include baseball fields, tennis courts, several parks, a swimming pool, a golf course, and ice-skating rinks. Indoor facilities include a bowling alley, two movie theaters, three gymnasiums, and a museum. The facilities are generally well-used. Forsyth residents are seeking funds for a new swimming pool because the existing pool does not meet State health standards. They also plan to add to the picnic and playground facilities and volleyball and basketball areas.

Colstrip's outdoor recreation facilities also include baseball fields, tennis courts, several parks and playgrounds, and a swimming pool. Indoor facilities include saunas, a weight room, a handball court, a racquetball court, and a gymnasium. The outdoor facilities are generally well-used; demand for the handball and racquetball courts is expected to exceed capacity soon. The gymnasium was designed for a population of 2,300 and is unable to accommodate the expanding population of Colstrip, estimated at 3,300 in July, 1980. The Colstrip Area Recreation and Parks Association plans to build a structure over the pool to make it useable year-round. A multipurpose room in the community center will be used for youth activities.

b. Non-urban recreation resources

Developed outdoor recreation facilities in Rosebud County include a motocross course and rodeo grounds; the Rosebud State Park near Forsyth (picnic sites, fishing, and boating); the Surge Pond Recreation Area near Colstrip (nonmotorized boating, picnic sites, and play fields), and various campgrounds and several rockhounding areas.

Undeveloped outdoor recreation resources in Rosebud County include the Yellowstone and Tongue Rivers, which are used for fishing, boating, and bird watching; about 233,000 acres of public land managed by the U.S. Bureau of Land Management; and about 100,000 acres of the Ashland Division of the Custer National Forest. Some private lands are open to public use, typically hunting and fishing. The influx of people associated with coal development has resulted in greater restrictions on access to private lands than any other part of region 8 of the Montana Department of Fish, Wildlife, and Parks, according to that agency (Neil Martin, oral commun., August 28, 1980).

The major recreation values of the public lands in the county are isolation, diverse topography, scenery, and big game. Neither the Ashland Division nor the B.L.M. lands offer many water-based recreational opportunities. Recreational use of these undeveloped lands continues to be low. Hunting is the primary use, but there are also opportunities for hiking, horseback riding, picnicking, photography, rock climbing, and similar uses.

Outdoor recreation use is not approaching capacity in the Colstrip area. The only recreational use projections for the Colstrip area are for the Ashland Division (U.S. Department of Agriculture, 1979). Without further energy development, recreational use of the Ashland Division will probably increase 5-10 percent in the next decade. Extensive development of coal (independent from Western Energy) could significantly alter recreational use--from approximately 37,800 recreation visitor days (RVDs) in 1975 to about 70,000 RVDs in 1985. Most of the increase would be from local users.

Recreation surveys conducted in the summer of 1976 and winter of 1977 by the Department of Fish, Wildlife, and Parks found that most residents of the area preferred recreation in undeveloped, natural areas. Nonmotorized types of recreation have the lowest capacities because undeveloped, unroaded areas are scarce: the only area currently proposed for wilderness designation by the Federal government is the Tongue River Breaks, a 16,000 acre roadless area in the Ashland Division. Recreational use of this and other roadless land in the area is low, however.

3. Impacts of the Proposal

Western Energy Area E employees and their families would continue to place part of the demand on recreational facilities in Colstrip and Forsyth and on non-urban resources in Rosebud County and adjacent counties. No new source of demand would be created because continued mining at Area E would not increase employment.

More recreational facilities are needed in Forsyth and Colstrip to accommodate the increased demand from the population associated with Colstrip generating units 3 and 4. Newcomers frequently comment on a lack of "things to do". Increased litter at outdoor recreation facilities would probably reduce the level of enjoyment for some recreationists.

Area E is not currently used for any recreational purpose. (Western Energy Co., written commun., July 9, 1980). Mining would eliminate any potential recreational use of this land throughout mine life. Recreational access to the minesite after reclamation would be determined by Western Energy or any subsequent landowner.

N. CULTURAL RESOURCES

1. Summary of Impacts

The loss of six archeological sites and one historic site would not be significant because none are eligible for inclusion on the National Register of Historic Places. None of the sites are unusual for the northern Great Plains, and none provide important information about prehistory or recent history.

2. Description of the Existing Environment

There are six archaeological sites in Area E, according to a Bureau of Land Management survey conducted in 1978 (cited in Fredlund, 1979). None of the sites are eligible for listing on the National Register of Historic Places. (Robert Archibald, Acting State Historic Preservation Officer, written commun. to Donald Crane, U.S. Office of Surface Mining, April 11, 1980). Five of the sites are lithic scatters (places used to make or sharpen tools) and one is a petroglyph that has since disappeared. The historic site is an abandoned undergound coal mine shaft. Old mine shafts are not unusual in the northern Powder River basin; the shaft in Area E contains no unique structures or architectural features. The five lithic scatters are very small, low density scatters with no subsurface materials. There is no potential to yield further information at the local level of prehistory. (Lynn Fredlund, Mineral Research Center, oral commun., May 5, 1980).

Area E was first inventoried for cultural resources in 1971. Subsequent surveys varied in their findings. The following discussion focuses on the more recent surveys.

In 1976 the area was surveyed under the direction of L. Lahren (cited in Fredlund, 1979) who reported four lithic scatters within the project area. A survey conducted in 1977 (Montana Department of State Lands, 1977) listed five archaeological sites in Area E, all of which were described as Ridgetop Occupation sites (lithic scatter areas). These sites were noted as WE #7, 8, 9, 10, and 25.

In 1978 the Bureau of Land Management resurveyed the area to verify the 1976 reports. Only three of the four lithic scatters (WE (#8, 9, and 10) were relocated. WE #7 was not relocated. In addition, the 1978 survey reported three previously unrecorded sites. Two were lithic scatters noted as WE #11 and #12. The third is the historic mine shaft described above, which was designated WE #13.

A poorly preserved petroglyph noted in the 1971 survey was recorded in 1973 as Alan's petroglyph. The site consisted of a single petroglyph panel on a sandstone outcrop. It possibly represented an animal with antlers. Deterioration of the figure was noted between 1971 and 1973 when the panel was traced on plastic film. The site was not relocated during the survey conducted in July, 1978. The figure had disappeared by 1979. This petroglyph site was of unknown cultural affiliation and could not be assigned to a particular time period with the current state of knowledge. It is doubtful that the panel was more than 500 years old based on the rate of deterioration of the sandstone (site report by Mineral Research Center contained in Western Energy's permit application). The rapid deterioration noted between 1971 and 1979 is not unusual in an area of heavy mine activity due to vibrations caused by blasting and heavy truck traffic (Howard Billian, Mineral Research Center, oral commun., May 28, 1980).

3. Impacts of the Proposal

The abandoned mine shaft (WE #13) would be mined out. Four lithic scatters (WE #7, 9, 10, and 11) would be covered by spoils in the highwall reduction area. One lithic scatter (WE #12) would be covered by soil storage. All of these sites would be effectively lost to future study. WE #8 is in an area which may be disturbed by associated mine activity such as vehicles. The loss of these resources would not be a significant impact because each site individually means very little to archeological knowledge. The distribution and location of the sites are important indicators of prehistory, but that information is recorded and would not be lost to mining (Lynn Fredlund, oral commun., June 11, 1980).

Undiscovered cultural resources may exist in the surveyed area and would be lost to mining, but the potential for significant undiscovered resources appears low, based on the intensity of surveys to date.

O. ESTHETICS

1. Summary of Impacts

Long term esthetic impacts would not be significant because the minesite's esthetic value, which is not distinctive for the region, would be largely restored after mining.

2. Description of the Existing Environment

The proposed mining area, although visually pleasant, is not esthetically distinctive from the surrounding landscape. The gentle to moderately steep sloping terrain, sandstone outcroppings, native range vegetation, scattered clumps of ponderosa pine on the ridges, and natural drainages contrast sharply in color and texture and visually dominate the proposed mining area.

The landscape to be mined typifies large portions of eastern Montana. Undisturbed lands surrounding Area E contain similar and, in places, more striking visual features, including greater terrain variety, denser stands of ponderosa pine, and more profuse and colorful rock outcroppings.

Most people view Area E from highway FAP 39. Few, if any, people visit the undisturbed portion of Area E specifically to view its scenery. Current mining in Area E and the nearby Colstrip power plant limits the esthetic value of the undisturbed portion of the area. The unmined area along the highway provides little screening of active mining in Area E.

The noise of the highway traffic, adjacent mining, and the power plant is evident throughout the undisturbed portion of Area E.

3. Impacts of the Proposal

Mining would create a sharp distinction between undisturbed areas and areas of stripped vegetation and topsoil. The mine cut and spoil piles would substantially change the form, color and texture of the area. The esthetic value of the slopes, sandstone outcroppings, ponderosa pine, rolling grassland, and natural drainages would be eliminated during mining. Regrading, revegetation, and reclamation of the mined area to approximately the original topography would substantially reduce long term impacts.

Reclaimed areas would contrast with the surrounding undisturbed areas, creating a strong unnatural line where they adjoin. This contrast would be evident because the reclaimed areas would have less form, texture, and color variation than the undisturbed lands.

The proposed mining would further reduce the screening of existing mining and associated disturbance as seen from the highway. After mining and reclamation, the noise of the nearby dragline and blasting would be gone, but industrial sounds from the power plant and traffic noise from the highway would remain.

CHAPTER III

ALTERNATIVES TO APPROVING THE PERMIT AS PROPOSED

This chapter considers alternatives to approval of Western Energy Company's proposed mine plan. The administrative alternatives available to the Department of State Lands include taking no action, denial of the permit, selective denial of portions of the permit, and approval of the permit subject to stipulations. Possible stipulations which would reduce environmental impacts are identified in chapter II as mitigating measures. Any of these alternatives could be chosen if necessary to reduce the environmental impacts of the proposed mining or to comply with legal requirements and the lease terms.

This chapter also discusses technological alternatives to the proposed strip mining of coal. The Department does not have the authority to require Western Energy to adopt any of these technological alternatives.

A. ADMINISTRATIVE ALTERNATIVES

1. Department of State Lands

a. No action

If no action were taken by the Department within 240 days after receipt of a complete application for a mining and reclamation permit, the permit would be statutorily approved by default.

Montana also does not have a formal administrative alternative to "defer action" following the receipt of a completed application for a mine and reclamation permit. However, the State may deem an application incomplete due to failure of the mine plan to meet State requirements, leading to a postponement of the action, which has the effect of deferral. Western Energy's application for Area E had not been deemed complete at the time this EIS was published. The changes that must be made in the application would not appreciably affect the analysis in this EIS.

b. Disapprove the permit

The Department may reject a proposed plan that does not meet Montana's permanent regulatory program (ARM 26.4.301 et. seq.). If Western Energy's current permit application were denied and no further permits were issued for Area E, the company would have to end its Area E operations in 1981, when the coal currently permitted for mining ran out.

Permit denial would prevent mining of 276 acres of Area E. All of those acres are currently bonded for lesser disturbance such as haul roads and highwall reduction under Western Energy's current permit.

Western Energy would likely propose an alternative mine plan within Area E if the current permit application were denied. The impacts of such a revised plan cannot be determined at this time. Until a revised mine plan were submitted and approved, the undisturbed portion of Area E would continue in its present condition, subject to modification by natural processes and by such nonmining uses as Western Energy might undertake.

Western Energy would have several options if mining in Area E were to cease. The company could truck coal from Areas A or B across the access road to Colstrip generating units 1 and 2. Production from Areas A or B would have to be expanded or else sales to out-of-state customers curtailed. There is no evidence that replacing Area E coal with Area A or B coal would reduce total environmental impacts from the Rosebud mine; the different mining areas operate under similar physical and social conditions.

Western Energy could build a receiving facility at Colstrip and ship in coal from a different mine. This would be expensive. The net difference in environmental impacts under this alternative cannot be predicted.

If Western Energy were not to replace Area E coal from another source, its parent company, Montana Power, would have to shut down Colstrip units 1 and 2. Montana Power would lose 30 percent and Puget Sound Power and Light 36 percent of their total generating capacity. To maintain the existing level of service to its customers, the two utilities would have to buy power elsewhere, with unknown environmental consequences.

Western Energy would still have the option of applying for mining permits on its undeveloped leaseholds, which could eventually supplant Area E coal. A new mine could not produce for at least several years, during which time one of the above options would apply. There is no evidence that mining a different part of Western Energy's leasehold would have lesser environmental impacts than mining Area E.

Summary of impacts under no permit scenario.

All but 23 acres of the 450-acre proposed permit area are currently bonded for associated disturbance. If the proposed permit were denied, Western Energy would disturb 160 acres of that area to reduce the existing highwall from the existing mining operations. Little additional land would be mined under the existing permit because the mine would shut down in 1981. All disturbed lands would be reclaimed and would probably support similar vegetation, wildlife, and land uses as if the same area were mined as proposed.

Hydrologic impacts would be somewhat less than if the permit were approved: seepage of saline water from impoundments could continue to slightly reduce agricultural productivity along Cow Creek for 10-20 years instead of 15-25 years. Seepage through the replaced mine spoils would probably extend this impact for the long term, although not as much as under the proposal because only half the volume of spoils would be created.

The six archaeological sites and the historical site would probably not be disturbed because they are outside the area to be mined under the existing permit.

Western Energy would have to truck more coal from Area B across FAP 39 to the Colstrip generating units, continuing the potential for disruption of traffic and serious accidents. Ten coal haulers would cross the highway every daylight hour for at least several years, compared to nine/hour during 1980.

Particulate and gaseous emissions from the mine would end 4 years sooner if the permit were denied. If production from Area E were replaced from Area B, particulate and gaseous emissions from coal hauler trucks would increase slightly because of the slightly greater haul distance.

Employment would not decrease if Western Energy increased production at Area B to compensate for lost production at Area E; consequently, social and economic impacts would not substantially differ from those under the proposed plan.

c. Selective denial

The Department could deny the permit to mine in a specified area having special, exceptional, critical, or unique characteristics, or where mining would affect the use, enjoyment, or fundamental character of neighboring land having the above special characteristics. The impact analysis contained in this EIS has not disclosed any such lands in or near Area E, but that does not preclude such action following review of this EIS.

d. Approve the permit with stipulations

Western Energy could be required to follow any of the mitigating measures discussed in chapter II and summarized below. The requirement would be in the form of stipulations attached to a permit.

1) Air quality

Coal dust emissions could be substantially reduced by watering the coal storage pile and using a baghouse in conjunction with the coal handling facilities (table II-6). If all the Best Available Control Technology (BACT) measures were implemented, coal dust emissions would be reduced from 400 tons/year to 116 tons/year, a 71 percent reduction. This would reduce potential health hazards to mine workers but would only slightly reduce ambient particulate concentrations at Colstrip.

Western Energy Company is presently using the BACT for the reduction of fugitive noncoal dust emissions (table II-6; U.S. Environmental Protection Agency, 1979). Minimization of the fall distance from the dragline during overburden replacement could reduce dust somewhat.

2) Soils

Western Energy currently plans to salvage the Cabbart and Yawdim soils to a depth greater than the average soil thickness. This would result in taking siltstone and shale bedrock material, which is not suitable for plant growth. DSL could require the company to salvage those series only to bedrock.

3) Hydrology

To reduce the temporary seepage of saline water from the impoundments, Western Energy could be required to seal the ponds. Alternatively, Western Energy could be required to drill wells downgradient through which the seepage could be periodically pumped out and returned to the ponds. To reduce contamination of ground water from saline spoils, Western Energy could be required to selectively replace the saline spoils between the ground water zone and the rooting zone.

The Department could require Western Energy to conduct additional water quality sampling in the Cow Creek drainage. This would help determine to what extent existing mining is degrading surface and ground waters. Ground water wells drilled downgradient of Area E would detect any movement of degraded spoils water into the interburden and the Rosebud and McKay aquifers.

2. Department of Health and Environmental Sciences

The Air Quality Bureau of the Department of Health and Environmental Sciences is reviewing the permit application submitted by Western Energy Company. The permit would be for the entire Rosebud mine, of which Area E is a part. The Air Quality Bureau must decide whether Western Energy's existing air quality permit will have to be amended.

Decisions of the Department of Health and Environmental Sciences are not contingent on those of the Department of State Lands, with the result that disapproval by either agency would cause rejection of the entire project.

B. TECHNOLOGICAL ALTERNATIVES

1. Alternative Mining Methods

Because Western Energy plans to complete mining at Area E in 1984, drastic changes in mining methods such as underground mining, contour mining, augur mining, or truck-and-shovel mining do not appear to be warranted. None of these alternative methods of extracting coal would significantly reduce environmental impacts at Area E, and all would be time-consuming and expensive to institute. DSL cannot require specific mining methods except as necessary to mitigate environmental impacts.

The Department could require Western Energy to mine the McKay coal seam which underlies the Rosebud seam, should the seam be proven to be marketable. DSL has to date been unable to prove whether the seam is marketable. Western Energy has not found a suitable market for the McKay coal due to the coal's tendency to form slag in some steam boilers. McKay coal, either alone or blended in large quantities with Rosebud coal, may not be useable in Colstrip generating units 1 and 2 or the Corette plant, the current consumers of Area E coal. The possibility exists that Western Energy could find a buyer for McKay coal or blended Rosebud-McKay coal; DSL will continue to encourage Western Energy to find such a market. Selling McKay coal alone from Area E would require separate handling of the coal. Blending the Rosebud and the McKay coal for sale outside Montana would at times require Western Energy to truck Rosebud coal from a different part of the Rosebud mine to the Area E surge pile, which feeds generating units 1 and 2.

Mining both the Rosebud and McKay seams at Area E would recover about one-third more coal per acre disturbed than mining the Rosebud seam alone. This would extend the life of Area E perhaps 2 years, thus delaying the requirement for coal from a new area of the Rosebud mine. Environmental impacts at Area E would not be appreciably increased: the major difference would be a greater need for fuel and electricity to remove the interburden and extract the additional coal. Because of the difficulty of regrading the additional waste material, the reclaimed land surface might be geomorphically less stable. Mining the McKay coal at Area E could, on the whole, have less environmental impact than mining additional land to produce an equivalent amount of coal.

Western Energy has planned its Area E operations around mining the Rosebud seam alone; mining the McKay seam would require considerable engineering changes which would lead to a temporary production delay at Area E during the changeover.

2. Alternative Energy Sources

Because coal from Area E feeds the existing Colstrip and Corette generating plants, which will be in operation well past 1984, it does not appear likely that other sources of energy will replace the demand for Area E coal. Alternative sources of energy, including nuclear, solar, and geothermal could well reduce the need for new coal-fired power plants but are not expected to replace electricity from plants now in operation.

A nationwide program of energy conservation could significantly slow the rate of growth of electric energy use, but conservation would not likely make existing generating facilities obsolete in the next 4 years, which is the projected remaining life of Area E.

CHAPTER IV

CONSULTATION AND COORDINATION

A. DEVELOPMENT OF THIS STATEMENT

The following individuals, agencies, and companies (other than those cited in the text) provided information used to analyze Western Energy Company's proposed permit amendment for Area E.

Government Agencies

Action for Eastern Montana (Miles City)

Montana Bureau of Mines and Geology (Butte)

Montana Department of Community Affairs:
- Community Development Division (Helena)

Montana Department of Fish, Wildlife, and Parks (Helena)

Montana Department of Health and Environmental Sciences:
- Water Quality Bureau (Helena)

U.S. Department of Agriculture:
- Soil Conservation Service (Forsyth)

U.S. Department of the Interior:
- Bureau of Indian Affairs (Billings)
- Bureau of Land Management (Billings and Miles City)
- Geological Survey, Water Resources Division (Helena)

Nongovernment

Hydrometrics (Helena)

Gene Kurtz, Mayor of Forsyth and Elementary School Principal

John Shorthill, Rosebud County Emergency Services Coordinator (Forsyth)

Ken Tiehart, Department of Mathematics, Montana State University (Bozeman)

Western Energy Company (Billings)

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The Department appreciates the assistance of Sherry Schwend, permit coordinator for Western Energy Company, who provided the EIS team with information and arranged visits to the minesite.

B. REVIEW OF THIS STATEMENT

In accordance with the Department's regulations governing environmental impact statements (EIS's), copies of this draft EIS will be made available to the public for comments and suggestions. All comments received will be carefully considered in the preparation of a final EIS. Written comments should be sent to Commissioner Gareth Moon, Department of State Lands, Capitol Station, Helena, MT 59620.

The draft EIS is available for review in the following places:

- Montana Department of State Lands, 1625 11th Avenue, Helena, Montana
- Big Horn County Public Library, 419 North Custer Ave., Hardin, Mont.
- Miles City Public Library, 1 South 10th, Miles City, Mont.
- The Rosebud County Library, 201 North 9th Ave., Forsyth, Mont.
- Parmley Billings Public Library, 510 North Broadway, Billings, Mont.
- Sheridan County Fulmer Public Library, 320 North Brooks, Sheridan, Wyoming.

A limited number of copies are available on request from the Department of State Lands, Capitol Station, Helena, MT 59620.

CHAPTER V

REFERENCES

Bohn, R., and Cowherd, C. Jr., 1977, Fugitive dust emissions evaluation, draft final report: MRI Project No. 5-1655-L, Kansas City, Mo., 11 p.

Bohn, R., Cuscino, T. Jr., and Cowherd, C. Jr., 1978, Fugitive emissions from integrated iron and steel plants: EPA-600/2-76-050, MRI, Kansas City, Mo.

Botz, M. K., 1978, Characteristics and potential impacts of wastewaters from a coal-fired power plant at Colstrip, Montana: report to Water Quality Bureau, Montana Department of Health and Environmental Sciences, 67 p.

Botz, M. K., 1979, Draft copy, Western Energy Company alluvial valley floor assessment, mining area B: unpublished report.

Chaiken, R. F., Cook, E. B., and Ruhe, T. C., 1974, Toxic fumes from explosives: ammonium nitrate-fuel oil mixtures: report of investigations 7867, Pittsburgh Mining and Safety Research Center, USDI Bureau of Mines, 24 p.

Colorado School of Mines Research Institute, 1980, Soil-depth requirements for reclamation of surface-mined areas: Proj. No. J60358.

Critchfield, H. J., 1966, General climatology: Englewood Cliffs, N.J., Prentice-Hall, 446 p.

Curtis, W. R., 1979, Surface mining and the hydrologic balance: Mining Congress Journal, July, 1979.

Dollahite, J. W., Rowe, L. D., Cook, L. M., Hightower, D., Mailey, E. M., and Kyzar, J. R., 1972, Copper deficiency and molybdenosis intoxication associated with grazing near a uranium mine: Southwestern Veterinarian, v. 9, p. 47-50.

Dollhopf, D. J., Goering, J. D., Levine, C. J., Bauman, B. J., Hedberg, D. W., and Hodder, R. L., 1978a, Selective placement of coal stripmine overburden in Montana; III, spoil mixing phenomena: Bozeman, Montana Agricultural Experiment Station, Research Report 135, 68 p.

Dollhopf, D. J., Hall, W. D., Schafer, W. M., DePuit, E. J., and Hodder, R. L., 1978b, Selective placement of coal stripmine overburden in Montana, v. I, data base: Bozeman, Montana Agricultural Experiment Station, Research Report 128, 109 p.

Dollhopf, D. J., Hall, W. D., Cull, C. A., and Hodder, R. L., 1978c, Selective placement of coal stripmine overburden in Montana, v. II, initial field demonstration: Bozeman, Montana Agricultural Experiment Station, Research Report 125.

Dollhopf, D. J., Wendt, D. J., Goering, J. D., and Hedberg, D. W., 1979a, Hydrogeology of a watershed with subirrigated alluvial materials in crop production, v. I, mined land reclamation: Bozeman, Montana Agricultural Experiment Station, Bulletin 715.

Dollhopf, D. J., Goering, J. D., Levine, C. J., Bauman, B. J., and Hodder, R. L., 1979b, Selective placement of coal strip mine overburden in Montana, v. IV, hydrogeologic studies: Bozeman, Montana Agricultural Experiment Station, Research Report 154.

Dollhopf, D. J., Levine, C. J., and Bauman, B. J., 1980, Reclamation advances in the selective placement of overburden, in adequate reclamation of mined land? a symposium, Billings, Montana, March 26-27, 1980.

Ecological Consulting Service, 1973, Annual report to the Montana Power Company and Western Energy Company, wildlife investigations, 10 x 20 area: Colstrip, Montana, Proj. No. 9-01-A, 103 p.

______1975a, The Montana Power Company, Colstrip 10 x 20 area, wildlife and wildlife habitat annual monitoring report: Proj. No. 71-23-A, 75 p.

______1975b, Vegetation production, condition, and community typing on Western Energy Mine Areas A, B, and E: Proj. No. 107-23-A, 45 p.

______1976, The Montana Power Company, Colstrip 10 x 20 area, wildlife and wildlife habitat annual monitoring report: Proj. No. 135-85-A, 54 p.

______1977, Western Energy Company, wildlife and wildlife habitat annual monitoring report: Proj. No. 164-85-A, 58 p.

______1978, Western Energy Company, annual wildlife report of the Colstrip area: Proj. No. 195-85-A, 100 p.

______1979, Western Energy Company, annual wildlife report of the Colstrip area including a special raptor research study: Proj. No. 216-85-A, 82 p.

Erdman, J. A., 1978, Potential toxicologic problems associated with strip mining, in Geochemical survey of the Western Energy regions: open-file report No. 78-1105, U.S. Department of the Interior, Geological Survey.

Erdman, J. A., Ebens, R. J., and Case, A. A., 1978, Molybdenosis--a potential problem in ruminants grazing on coal mine spoils: Journal of Range Management, v. 31, no. 1, p. 34-36.

Fairman, P. R., O'Brien, R. J., Swecker, S., Amandus, H. E., and Shoub, E. P., 1977, Respiratory status of surface coal miners in the United States: Archives of Environmental Health, v. 31, p. 211-215.

Fredlund, L., 1979, Reassessment of cultural resources, Area E sections 1, 2, 11, and 12, T. 1 N., R. 41 E. Butte, Mont., Mineral Research Center, 7 p.

Gold, R. L., 1974, A comparative case study of the impact of coal development on the way of life of people living in the coal areas of eastern Montana and northeastern Wyoming: Missoula, University of Montana, Institute for Social Research, 185 p.

______1975, A study of social impact of coal development in the Decker-Birney-Ashland area: Missoula, University of Montana, Institite for Social Research, final report for Montana Energy Advisory Council, 76 p.

Heimbach, J. A., and Super, A. B., 1973, Air pollution potential determination for Colstrip, Montana: Bozeman, Montana State University, Dept. of Earth Sciences, final report, part II.

Klarich, D. A., and Thomas, J., 1977, The effect of altered stream flow on the water quality of the Yellowstone River Basin, Montana, Yellowstone impact study technical report no. 3: Water Resources Division, Montana Department of Natural Resources.

Kubota, J., 1975, Areas of molybdenum toxicity to grazing animals in the western states: Journal of Range Management, v. 28, p. 252-256.

McWhorter, D. B., Skogerboe, B. K., Skogerboe, G. V., 1975, Water quality control in mine spoils upper Colorado River Basin: EPA-670/2-75-048, U.S. Environmental Protection Agency, Cincinnati, Ohio.

Meadowlark Group, 1978, Report to the Department of State Lands on the economic impact of the Big Sky mine expansion: Helena, Mont., 263 p.

Miller, J. F., Frederick, R. H., and Tracey, R. J., 1973, Precipitation-frequency atlas of the western United States, v. I, Montana: U.S. Department of Commerce, Silver Spring, Maryland.

Miller, R. M., and Cameron, R. E., 1976, Some effects on soil microbiota of topsoil storage during surface mining, in Fourth symposium on surface mining and reclamation: NCA/BCR coal conference and expo III, Louisville, Kent.

Montana Bureau of Mines and Geology and U.S. Department of the Interior, Geological Survey, 1978, Ground water of the Fort Union coal region, eastern Montana: Montana Bureau of Mines and Geology Special Publication 80.

Montana Department of Health and Environmental Sciences, 1980, Authorization to discharge under the Montana pollutant discharge elimination system: unpublished permit authorization report.

Montana Department of Health and Environmental Sciences, 1980, Final environmental impact statement on the Montana ambient air quality standards study: 2 vols.

Montana Department of Highways, 1978, Montana primary highways sufficiency ratings: prepared by the Planning and Research Bureau in cooperation with the U.S. Department of Transportation, Federal Highway Administration, December 31, 1978, 188 p.

Montana Department of Labor and Industry, 1980, Montana employment and labor force: monthly report, v. 10, no. 2, 68 p.

Montana Department of State Lands, 1977, Final environmental impact statement for the proposed expansion of Western Energy Company's Rosebud mine into areas A and E: Helena, Mont., 236 p.

______1980, Final environmental impact statement, Western Energy Company's Rosebud mine, Area B extension: Helena, Mont., 126 p.

Munshower, F. F., and DePuit, E. J., 1976, The effects of stack emissions on the range resources in the vicinity of Colstrip, Montana: program report 1975: Bozeman, Montana Agricultural Experiment Station, 109 p.

Munshower, F. F., Depuit, E. J., and Neuman, D. R., 1977, The effects of stack emissions on the range resource in the vicinity of Colstrip; Montana pre-operational description of the range ecosystem: Bozeman, Montana Agricultural Experiment Station, Research Report no. 126, 196 p.

Neff, E. L., 1980, Using sodium carbonate to seal leaky stock ponds in eastern Montana: Journal of Range Management v. 33, no. 4.

Old West Regional Commission, 1979, Mineral fuels taxation in the Old West region: prepared by Mountain West Research, Inc., Billings, Mont., 308 p.

Public Library Association, 1962, Interim standard for small public libraries: guidelines toward achieving the goals of library service.

Rhoades, J. D., and Halvorson, A. D., 1977, Electrical conductivity methods for detecting and delineating saline seeps and measuring salinity in Northern Great Plains soils: U.S. Department of Agriculture, Agricultural Research Service, ARS W-42.

Rosebud County Planning Board, 1979, Planning data book and comprehensive plan, 181 p.

Sauchelli, V., 1969, Trace elements in agriculture: New York, Van Nostrand Reinhold Co., 248 p.

Schaefer, M., Elifrits, D., and Barr, D. J., 1979, Sculpturing reclaimed land to decrease erosion, in Symposium on surface-mining hydrology, sedimentology, and reclamation: Lexington, University of Kentucky.

Schafer, W. M., Nielsen, G. A., Dollhopf, D. J., and Temple, K., 1979, Soil genesis, hydrological properties, root characteristics and microbial activity of 1- to 50-year-old stripmine spoils: Bozeman, Montana Agricultural Experiment Station, 209 p.

Skogerboe, R. K., Miller, M. M., Dick, D. L., Thurston, R. V., and Russo, R. C., The water quality of Rosebud Creek, Montana, 1975-1977: compilation of chemical data: NREL-FBL technical report no. 4, March, 1980.

Spadling, R. F., and Exner, M. E., Areal, vertical and temporal differences in ground water chemistry: v. I, inorganic constitutents: Journal of Environmental Quality, v. 9, no. 3.

Super, A. B., Heimback, J. A., and Partland, J. T., 1973, Air pollution potential determination for Colstrip, Montana, final report, part 1: Bozeman, Montana State University, Department of Earth Sciences.

Tisdale, S. L., and Nelson, W. L., 1975, Soil fertility and fertilizers, 3d ed.: New York, Macmillan Co., 694 p.

Toy, T. T., and Munson, B. E., 1978, Climate appraisal maps of the rehabilitation potential of strippable coal lands in the Powder River Basin, Wyoming and Montana: U.S. Department of the Interior, Geological Survey, Reston, Virginia, 2 p.

U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1977, Preliminary guidance for estimating erosion on areas disturbed by surface mining activities in the interior western United States: EPA-908/4-77-005.

U.S. Department of Agriculture, Forest Service, 1979, Final environmental statement, Ashland planning unit, land management plan: Washington, U.S. Government Printing Office, 52 p.

U.S. Department of Agriculture, Salinity Laboratory, 1954, Diagnosis and improvement of saline and alkali soils: U.S.D.A. Handbook 60.

U.S. Department of Agriculture, Soil Conservation Service, n. d., Montana grazing guide, 74 p.

U.S. Department of Commerce, 1979, Bureau of Economic Analysis, Regional Economic Information System, unpublished data from table 25.00, "Employment by type and broad industrial source 1972-77, full and part-time wage and salary employment plus number of proprietors", Washington, D.C., 1979.

U.S. Department of Housing and Urban Development, 1976, Rapid growth from energy projects, 59 p.

U.S. Department of the Interior, 1970-80, Report of labor force: Bureau of Indian Affairs, unpublished annual report, form 5-2119.

U.S. Department of the Interior and Montana Department of State Lands, 1980, Final environmental statement, regional analysis, northern Powder River basin coal, Montana (FES 80-1), 4 vols.

U.S. Department of the Interior, 1979, Final proposed Colstrip project environmental statement, Rosebud County, Montana (FES 79-29), 3 vols., 344 p.

U.S. Department of Interior, Bureau of Reclamation, 1977, Economic/demographic assessment manual: prepared by Mountain West Research, Inc., Tempe, Ariz., 300 p.

U.S. Environmental Protection Agency, 1973, Air quality and emission trends national air monitoring program annual report, vol. 2: EPA 450/1-73-001.

U.S. Environmental Protection Agency, 1976, Compilation of air pollution emission factors: AP-42 Part B, 2d ed., Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1972, Helena valley, Montana, area environmental pollution study, Office of Air Programs Publication No. AP-91: Research Triangle Park, N.C., 179 p.

U.S. Environmental Protection Agency, 1979, Compilation of past practices and interpretations by EPA Region VIII on air quality mining, 17 p.

Van Voast, W. A., Hedges, R. B., and McDermott, J. J., 1977, Hydrological conditions and projections related to mining near Colstrip, southeastern Montana: Montana Bureau of Mines and Geology Bulletin 102.

Van Voast, W. A., Hedges, R. B., and McDermott, J. J., 1978, Completion report, hydrological characteristics of coal mine spoils, southeastern Montana: Montana University Joint Water Resources Research Center, Report No. 94.

Wischmeier, W. H., and Meyer, L. D., 1973, Soil erodibility on construction sites: Conference-Workshop on soil erosion, Washington, D.C., 1973, proceedings published by the Highway Research Board, C. Stewart, ed.

CHAPTER VI

APPENDIXES

APPENDIX B-1.--Spoil water quality at the Rosebud mine

TDS mg/l	Age of Spoils (years)	Location	Well No.	No. of Well Samples
5,466	55	NE Corner Area E	W-2	2
2,654	55	NE Corner Area E	W-3	1
3,170	55	NE Corner Area E	W-4	8
3,701	55	NE Corner Area E	W-5	1
3,099	55	SE Corner Area E	S-09	1
3,959	55	SE Corner Area E	S-10	1
Average: 3,675				
2,619	22	Pit 6	S-1	15
2,008	22	Pit 6	S-2	15
1,158	12	Pit 6	EPA-3	2
2,226	12	Pit 6	EPA-10	1
1,096	12	Pit 6	EPA-12	1
Average: 1,821				
2,875	3-5	Area A	WS-106	2
Average: 2,875				
4,419	2-3	Area B	CR-2	7
1,920			D-2	3
Average: 3,751				
Total Average Spoil Quality: 2,700 mg/l TDS				

APPENDIX B-2.--Comparison of shallow alluvial ground water quality of South Fork Cow Creek (downgradient of Area E) and adjacent streams not impacted by mining

Alluvium Ground Water Quality (TDS) mg/l	Location	Well No.	Data Source	Date
5,050	South Fork Cow Creek just downstream of Area E & Pit 6 (Probably affected by mining)	S-05	Van Voast & others, 1977	09/25/73
4,530		S-05	"	02/04/74
4,710		S-05	"	06/16/74
4,520		S-05	"	02/05/75
6,000		S-05	WECo Unpublished data, 1980	10/31/79
5,895		S-05		12/18/79
6,150		S-05	"	02/21/80
Average: 5,265				
2,340	Emile (Coalbank) Coulee 2 miles south of Area E (not affected by mining)	BS-11	Van Voast & others, 1977	08/28/75
2,090		BS-12	"	08/28/75
2,960		BS-13	"	08/28/75
3,290		BS-14	"	08/28/75
Average: 2,670				
2,209		13	Dollhopf & others, 1979a	05/10/76
2,306		13	"	01/14/77
2,210		13	"	03/18/77
2,031		13	"	05/17/77
2,157		13	"	07/26/77
2,195		13	"	10/30/77
2,202		13	"	05/31/78
2,361		13	"	08/24/78
Average: 2,209				
1,769		27	Dollhopf & others, 1979a	01/14/77
1,824		27	"	03/18/77
1,630		27	"	05/17/77
1,974		27	"	07/26/77
1,685		27	"	10/30/77
1,911		27	"	05/31/78
1,777		27	"	08/24/78
Average: 1,796				
Total Emile Coulee Average: 2,154				
1,860	Pony Creek 3 miles north of Area E (not affected by mining)	WA-112	WECo Unpublished data, 1980	12/05/79

APPENDIX B-3.--Rosebud coal aquifer water quality (samples taken upgradient west of Area E)

TDS mg/l	Source	Location	Well No.	No. of well samples
1,880	Van Voast & others, 1977	1N40E 13 CCDC	S-24	1
1,410	"	IN40E 15 BBAB	P-10	1
2,520	"	IN40E 15 BBDA	P-09	1
1,750	"	IN40E 15 BBBB	P-08	2
1,000	"	IN40E 15 BDBD	P-07	5
1,830	"	IN41E 10 AACD	S-28	2
820	"	IN41E 16 BAB	S-19	2
1,301	Dollhopf & others, 1977	IN41E 3 (Area B)	4-R	1
2,466	"	"	5-R	1
1,134	"	"	7-R	1
854	"	"	28-R	1
636	"	"	29-R	1
653	"	"	30-R	1
1,873	"	"	31-R	1
1,050	"	"	32-R	1
1,245	"	"	33-R	1
1,935	"	"	34-R	1

Average: 1,433

APPENDIX F-1.--Seed mixtures proposed for Area E

LOWLAND/DRAINAGE MIXTURE

Common Name	Scientific Name	% Total Mix (PLS)*
Rosana western wheatgrass	*Agropyron smithii*	30
Slender wheatgrass	*Agropyron trachycaulum*	20
Thickspike wheatgrass	*Agropyron dasystachyum*	10
Mountain brome	*Bromus marginatus*	10
Kentucky bluegrass	*Poa pratensis*	10
Canada bluegrass	*Poa compressa*	10
Canada wildrye	*Elymus canadensis*	10

UPLAND MIXTURE

Common Name	Scientific Name	% Total Mix (PLS)*
Rosana western wheatgrass	*Agropyron smithii*	30
Critana thickspike wheatgrass	*Agropyron dasystachyum*	20
Green needlegrass	*Stipa viridula*	20
Slender wheatgrass	*Agropyron trachycaulum*	10
Prairie sandreed	*Calamovilfa longifolia*	10
Side-oats grama	*Bouteloua curtipendula*	10

STEEP UPLAND MIXTURE

Common Name	Scientific Name	% Total Mix (PLS)*
Rosana western wheatgrass	*Agropyron smithii*	25
Green needlegrass	*Stipa viridula*	25
Side-oats grama	*Bouteloua curtipendula*	15
Bluebunch wheatgrass	*Agropyron spicatum*	15
Thickspike wheatgrass	*Agropyron dasystachyum*	10
Prairie sandreed	*Calamovilfa longifolia*	10

*Total mix pure live seed (PLS) will be based on the number of seeds per pound of each species. Seeding rates will be 20 lbs/acre PLS. Wintergraze will be planted at 5-10 lbs/acre PLS.

SUPPLEMENTAL MIXTURE

[Used in conjunction with each of the three range mixtures]

Common Name	Scientific Name	% Total Mix (PLS)*
Needleandthread	*Stipa comata*	20
Indian ricegrass	*Oryzopsis hymenoides*	20
Big bluestem	*Andropogon gerardi*	10
Sand bluestem	*Andropogon hallii*	10
Little bluestem	*Schizachyrium scoparium*	5
Fourwing saltbush	*Atriplex canescens*	5
Winterfat	*Ceratoides lanata*	5
Blue grama	*Bouteloua gracilis*	5
Lewis flax	*Linum lewisii*	5
Prairie coneflower	*Ratibida columnifera*	5
Western yarrow	*Achillea millefolium lanulosa*	5
Purple prairie clover	*Petalostemon purpureum*	3
White prairie clover	*Petalostemon candidum*	2

INDIGENOUS TREES AND SHRUBS FOR REVEGETATION

Common Name	Scientific Name
Box elder	*Acer negundo*
Silver sagebrush	*Artemisia cana*
Big sagebrush	*Artemisia tridentata*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Green rabbitbrush	*Chrysothamnus viscidiflorus*
Fleshy hawthorn	*Crataegus succulenta*
Green ash	*Fraxinus pennsylvanica*
Rocky Mountain juniper	*Juniperous scopulorum*
Ponderosa pine	*Pinus ponderosa*
Narrow leaf cottonwood	*Populus angustifolia*
Plains cottonwood	*Populus deltoides*
American plum	*Prunus americana*
Chokecherry	*Prunus virginiana*
Skunkbush sumac	*Rhus trilobata*
Golden current	*Ribes aureum*
Squaw current	*Ribes cereum*
Redshoot gooseberry	*Ribes setosum*
Woods rose	*Rosa woodsii*
Peachleaf willow	*Salix amygdaloides*
Tealeaf willow	*Salix phylicifolia*
Western snowberry	*Symphoricarpos occidentalis*
Buffalo berry	*Sheperdia argentea*
Yucca	*Yucca glauca*

APPENDIX G-1.--Vegetative habitat types associated with various wildlife species in the Colstrip area

Species	Existing Vegetative Habitat Types[1]	Proposed Postmining Habitat Types[2]
Mule Deer (*Odocoileus hemionus*)	211, 212.1, 212.2, 213, 351, 352	1, 3, 4, 5, 6, 7, 8, 9, 10, 11
Pronghorn Antelope (*Antilocapra americana*)	111.2, 111.3, 111.4, 211, 212.1, 212.2	2, 4, 5, 6, 7, 8, 11, 12, 13
Sharp-tailed Grouse (*Pedioecetes phasianellus*)	111.2, 111.3, 111.4, 211, 212.1, 212.2, 213	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Sage Grouse (*Centrocercus urophasianus*)	211, 212.1, 212.2	4, 5, 6, 7, 8, 11
Hungarian Partridge (*Perdix perdix*)	111.2, 111.3, 111.4, 211, 212.1, 212.2, 213, 351, 352	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Merriam's Turkey (*Meleagris gallopavo merriami*)	351, 352	1
Raptors	351, 352, S	1, S

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[1] Existing (premining) vegetative habitat types and code numbers (Ecological Consulting Service, 1975):

111.2	*Agropyron smithii*--*Koelaria cristata*--*Carex filifolia*
111.3	*Stipa comata*--*Carex filifolia*--*Koelaria cristata*
111.4	*Calamovilfa longifolia*--*Andropogon* spp.
211	*Artemesia tridentata*--*Koelaria cristata*--*Agropyron spicatum*
212.1	*Artemesia cana*--*Agropyron smithii*--*Stipa viridula*--*Bromus* spp.
213	*Rhus trilobata*--*Stipa comata*--*Agropyron smithii*
351	*Pinus ponderosa*--*Agropyron spicatum*
352	*Pinus ponderosa*--*Juniperus scopulorum*--*Agropyron spicatum*
S	Sandstone outcrops

[2] Proposed postmining vegetative habitat types and code numbers. Appendix F-1 shows composition of seed, tree, and shrub mixtures.

1 *Pinus ponderosa*--*Rhus trilobata*
2 Lowland drainage mixture--supplemental mixture--selected lowland mixture
3 *Rhus trilobata*--steep upland mixture--supplemental mixture
4 *Artemesia cana*--upland mixture--supplemental mixture
5 *Artemesia tridentata*--lowland drainage mixture--supplemental mixture--selected lowland trees and shrubs from a list of indigenous trees and shrubs
6 *Artemesia cana*--steep upland mixture--supplemental mixture
7 *Artemesia cana*--lowland drainage mixture--supplemental mixture--selected lowland trees and shrubs from a list of indigenous trees and shrubs
8 *Artemesia tridentata*--steep upland mixture--supplemental mixture
9 *Rhus trilobata*--lowland drainage mixture--supplemental mixture--selected lowland trees and shrubs from a list of indigenous trees and shrubs
10 *Rhus trilobata*--upland mixture--supplemental mixture
11 *Artemesia tridentata*--upland mixture--supplemental mixture
12 Upland mixture--supplemental mixture
13 Steep upland mixture--supplemental mixture
S Sandstone outcrops

APPENDIX I-1.-- Disposition of the coal severance tax collection according to 15-35-108,MCA

[Data are in percent of total collection]

	July 1, 1977 to June 30, 1979	July 1,1979 to December 31,1979	January 1,1980 to next change
Constitutional trust fund--------------	25.0	25.0	50.0
General fund--------------	30.0	28.875	19.0
Local impact and education trust fund----	19.875	28.125	18.75
Coal area highway improvement-------------	9.75	0.0	0.0
State public school equalization------------	7.5	7.5	5.0
Alternative energy research, development and demonstration-------	1.875	1.875	2.5
Renewable resource development bond account (sinking fund)--	1.875	1.875	1.25
Parks and art-------------	1.875	3.75	2.5
Producing county----------	1.5	1.5	0.0
County planning (statewide)-------------	0.75	0.75	0.5
State library commission--	0.0	0.75	0.5
Total--------------------	100.0	100.0	100.0

APPENDIX I-2.--Summary of the cost to the consumer of the Montana severance tax, 1979

Utility	Quantity[1] (1000s tons)	Cost of Montana Coal Dlvrd[1]	f.o.b.[2]	C.S.P.[3]	Sev Tax per ton[4]	Sev Tax paid	Residential % of Total Kwh Sales[5]	Avg # of Residential Customers[5]	Cost per Residential Customer
Central Illinois Light	686.9	$27.89	$11.57	$ 8.08	$2.42	$ 1,662,000	31.3	163,455	$3.18
Commonwealth Edison	4,185.2	33.62	15.83	11.28	3.38	14,146,000	27.7	2,676,826	1.46
Detroit Edison	2,500.0	26.17	13.36	9.45	2.84	7,100,000	27.8	1,603,624	1.23
Interstate Power	247.4	24.46	7.97	5.49	1.65	408,000	20.8	108,855	0.78
Lower Colorado River Auth.	804.5	35.55	17.43	12.47	3.74	3,008,000	4.6	16,566	8.35
Minnesota Power & Light	2,783.6	17.68	7.84	5.50	1.65	4,600,000	8.0	91,422	4.03
Montana Dakota Utlities	303.9	10.33	10.33	6.704	1.34	380,082	47.8	86,721	2.09
Montana Power Company	1,942.5	5.75	5.48	3.72	1.12	2,168,000	22.5	187,701	2.60
Northern States Power	8,348.2	16.51	5.50	3.73	1.12	9,350,000	24.4	949,499	2.40
Puget Sound Power & Light	1,231.0	6.28	6.28	4.30	1.29	1,588,000	56.9	458,220	1.76
Wisconsin Power & Light	2,064.6	15.12	6.44	4.41	1.32	2,725,000	38.8	259,550	4.07

[1] Delivered cost. Source: U.S. Department of Energy 1980, Form 423 summary, unpublished printout.
[2] f.o.b., freight on board, delivered cost less estimated transportation charges.
[3] C.S.P., contract sales price, fob=CSP + 0.3CSP[a] + 0.005CSP[b] + (0.45)(CSP)(Mill levy)[c] + $0.35[d] + 0.02 f.o.b.[e]
[4] 30 percent of CSP.
[5] Source: Uniform Statistical Report for year ended December 31, 1979.
[a] Montana Severance Tax.
[b] Resource Indemnity Trust Tax.
[c] Gross Proceeds (local ad valorem property tax).
[d] Federal Abandoned Mine Reclamation Fee.
[e] Federal Black Lung Tax, has an upper limit of $0.25 per ton.

APPENDIX I-3.--Method for calculating the effect of the pending Federal royalty increase on the contract sales price of Area E coal and the cost of Montana Power Company's residential electricity

The net effect of royalty increase was estimated in the following fashion:

F.O.B. - Federal royalty - black lung excise tax = Federal base
Substituting 1979 Area E prices this becomes:
$5.48 - $0.15 - $0.11 = $5.48 - $0.26 = $5.22

When Section 2 is mined, the provisions of lease M 035735 go into effect and the royalty goes to 23 percent of F.O.B. The black lung excise tax remains at 2 percent of F.O.B. Therefore,

$$\text{F.O.B.} = \frac{\text{Federal base}}{.77} = \frac{\$5.22}{.77} = \$6.779$$

and so Federal royalty and black lung = $1.559 [.23($6.779)].

This causes an increase in the F.O.B. price of $1.299 ($1.559-0.26).

Production taxes then go up by .348 of the initial increase or $0.452.

Federal royalty and black lung excise tax increase by .23 of the production tax increase or $0.104.

The process continues, until the increase is less than $0.001 and results in a total F.O.B. increase of $1.903.

Summary of increases:

initial increase $1.299
1.299 x .348 = 0.452
0.452 x .230 = 0.104
0.104 x .348 = 0.036
0.036 x .230 = 0.008
0.008 x .348 = 0.003

0.003 x .230 = 0.001
0.001 x .348 = 0.000

$1.903

Hence the F.O.B. price becomes:

$$\begin{array}{r} \$5.480 \\ +\ \underline{1.903} \\ \$7.383 \end{array}$$

The contract sales price is determined using the equation:

$$CSP = FOB - 0.35^{a} - (0.02)FOB^{b} - (0.3)CSP^{c} - (0.005)CSP^{d} - (0.043)CSP^{e}$$

or

$$1.348\ CSP = .98\ FOB - 0.35, \text{ and so}$$

$$CSP = \frac{(.98)\ (7.383) - 0.35}{1.348} = \$5.108$$

[a] Abandoned mine reclamation tax
[b] Black lung excise tax (has an upper limit of $0.25 per ton)
[c] Montana Severance Tax
[d] Montana Resource Indemnity Trust Tax
[e] Local property taxes (Gross Proceeds)--assumes a 95-mill levy

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